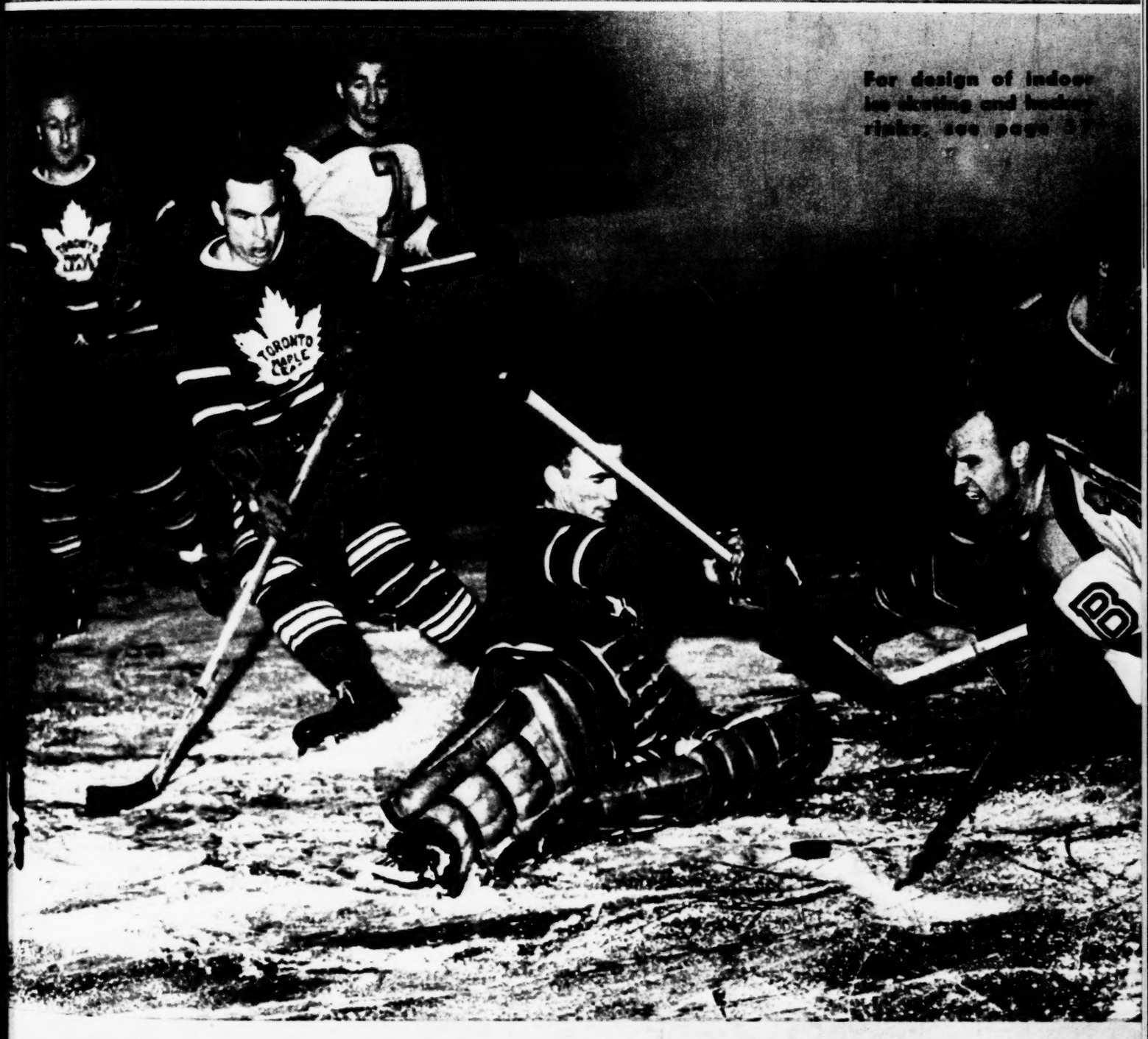
APR 16 19

HEATING AND VENTILATING

AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION



For design of indoor ice skating and hockey rinks, see page 37

Selection of Unit Heaters . . page 67

Direct Control of Welding Exposures . . . . page 82

Heat Transfer Film Coefficient for Freon . . . . . page 62

Introducing Make-up Air . . page 65

SETTING NEW RECORDS YEAR AFTER YEAR!

CAN YOU IMAGINE more than a thousand test-checked motors an hour spewing from assembly lines?

Well, the Redmond Company does it, right on through the calendar, setting new records year after year!

Redmond Micromotors are little fellows, in the twentieth horsepower class. Every day millions of them quietly perform countless tasks in homes, stores, garages, restaurants and factories, in automobiles, ships, planes and trains.

Producing these dependable Micromotors is no job for a novice. The Redmond plants have hundreds of specialists who for years have lived with their work day and night, magically conjuring up still better Micromotors, faster methods, and unique production equipment unheard of by the motor industry.

Yes, sir, we get a real thrill out of setting new records. And we aim to do it again this year.

Redmond COMPANY, Inc., OWOSSO, MICHIGAN, U. S. A.

VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

Published by

THE INDUSTRIAL PRESS
Also publishers of MACHINERY and technical books

President
ROBERT B. LUCHARS

Vice-President and Treasurer
EDGAR A. BECKER

Secretary
ERIK OBERG

Editorial Staff

Editor
CLIFFORD STROCK

Associate Editor
N. N. WOLPERT

Assistant Editor
WILLIAM FOXHALL

Business Staff

Publishing Manager
HAROLD L. GRAY
148 Lafayette Street
New York 13, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago 1, Ill.

Eastern Representative
HARRY J. TWINE
148 Lafayette Street
New York 13, N. Y.

Pacific Coast Representative
ROBERT H. DEIBLER
403 W. 8th St.
Los Angeles 14, Calif.

Publishing Information

HEATING AND VENTILATING is published monthly by The Industrial Press at 148 Lafayette Street, New York 13, N. Y. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents. Entered as second class matter, April 18, 1925, at the Post Office, New York, N. Y., under the act of March 3, 1879.

CONTENTS FOR APRIL, 1946

VOLUME 43 NUMBER 4

Washington News 53
Loring F. Overman

Design of Ice Skating Rinks 57
Charles H. Herter

Heat Transfer Film Coefficient for Liquid Freon-21 62
B. F. Raber and F. W. Hutchinson

Make-Up Air 65
T. W. Reynolds

Marine Air Conditioning Expands 66

Reference Section—Unit Heaters; Steam and Hot Water Types 67
J. E. York

Reference Data 315-316 78

Industrial Applications of the Dilution Principle 79
W. C. L. Hemeon

Engineering Control of Welding Exposures 82
B. F. Postman

Radiant Heating Under Hardwood Floor 88

The Comfort Bonus of Insulation 89

News of Equipment and Materials 93

News of the Month 100

Degree-Days for February, 1946 110

Abstracts and Reviews 114

New Catalogs 114

Getting Personal 120

Since the Last Issue 122

Industrial Degree-Days for February, 1946 130

Canadian Degree-Days for February, 1946 130

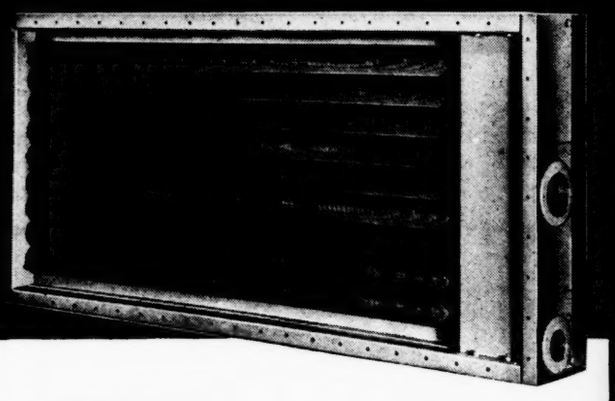
Coming Events 131

Copyright, 1946, by The Industrial Press

MEMBER
Audit Bureau of Circulation
Associated Business Papers

THIS MONTH'S COVER

Hockey ice, harder and colder than public skating ice, takes punishment as Boston Bruins play Toronto Maple Leafs. Press Association photo dramatizes rink construction article beginning page 57.



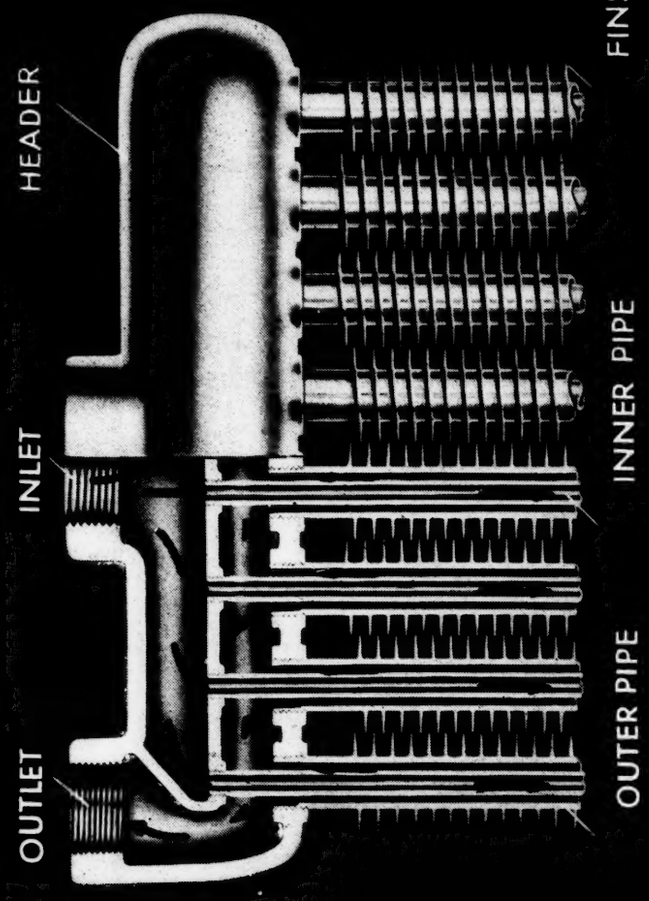
HERE'S WHY
STURTEVANT HEAVY DUTY HEATERS

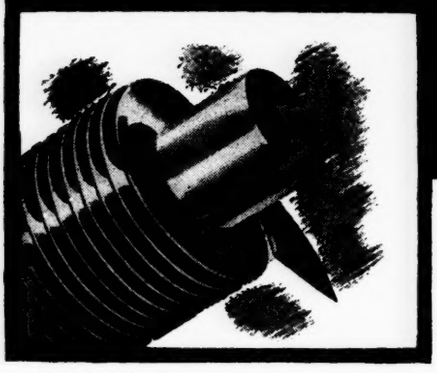
last longer... perform better

You can depend on it—Sturtevant will never try to cut costs by skimping on quality, as these rugged, Heavy Duty Heaters prove. Combining the high performance of lighter copper units with the sturdy construction of steel pipe coils, these heaters have far exceeded all guarantees in hundreds of installations.

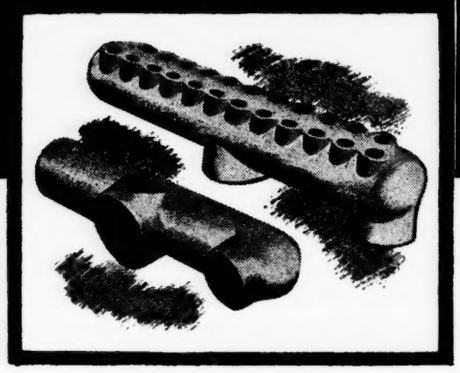
Basic construction consists of cast iron headers, and one-inch steel pipe with tapered spiral steel fins. Distributing pipes are three-eighths-inch steel, casing of heavy sheet metal.

Sturtevant Heavy Duty Heaters are available for heating, ventilating, air conditioning, vapor absorption and drying applications. For complete details, send for Catalog No. 462.

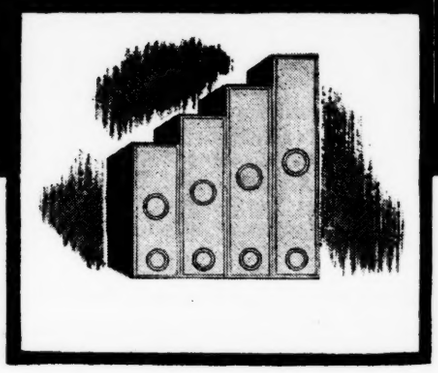




STEEL PIPES LAST LONGER. From the time the steam enters the heater until it returns via the condensate line, there are no "weak links" in the entire heater system, from boiler back to boiler.



INSTALLATION IS EASIER because of Sturtevant's *single-header* feature. This allows installation at almost any angle, vertical or horizontal. Headers are available for single or dual rows of coils, depending on heating capacity needed.



SIZE RANGE IS WIDER. Sturtevant Heavy Duty Heaters are available in the same wide range of sizes that are standard for copper units. They require no more space—compare favorably in cost and are particularly adapted to use with steam in the higher temperature ranges. ***Full year's guarantee.***

HEATING • VENTILATING • AIR CONDITIONING •

DRYING • DUST AND FUME CONTROL

Washington News

LORING F. OVERMAN

Chain Reactions.
Production.
Price Bending.
Construction Permits.
Veterans' Preference Project.

OF never-failing interest to those who watch Washington are the atom-like chain reactions set up whenever something happens under the Capitol dome or at 1600 Pennsylvania Avenue.

A big-wig makes a speech—unions the country over accept it as the official go-ahead to seek more pay.

Steel prices advance—a thousand manufacturing firms using steel clamor for an offsetting increase.

The Department of Commerce announces that industrial and commercial construction promise to show an increase during the first quarter of 1946—CPA counters with an order to make it difficult to secure building materials for anything but residential construction.

OPA puts a price on 2 x 4 lumber to hold down the cost of home construction—mills quit making 2 x 4's and turn to 2 x 4¼'s, which can be billed as 2 x 6's.

A labor leader threatens a coal strike—Washington begins to realize that this would mean another increase in steel prices, in steel wages, in adjustments to users ....and so on, 'round and 'round again.

The Only Answer – Production

Washington and its critics, its supporters and its watchers-with-interest appear to agree in the main on one thing—that production alone will solve the problem of the stalled reconversion machine. Recalling that this same machine, under wartime stimuli and in spite of price and wage controls, ground out enough things to lick the Axis and amaze the world, Washington finds it difficult to understand why the same conditions fail in peacetime.

One trouble seems to be that every producer wants to increase his prices without raising his costs. Very difficult, Washington agrees, but it is getting plenty of advice on the subject.

Capital Goods Group Speaks

Typical of the pleas that failure to permit certain price increases is blocking overall production, and that such increases would actually make prices lower instead of higher for consumers was one presented to the House Committee on Banking and Currency on March 12 by a panel of big-name representatives of the Machinery and Allied Products Institute. Products of institute members range from drills and cutting tools through such larger items as machine tools and diesel engines, giant hydraulic presses, rolling mills, cranes and locomotives. Many of these tools, if not actually used by units of the heating, ventilating and air conditioning industries, are employed by those who supply these industries with necessary components.

In a 10-page brief, the institute argued that America cannot duplicate its wartime output until it is retooled for peace just as it was for war; that the use of high-capacity machines offers the only means of offsetting higher labor and raw material costs; that it cannot manufacture such machines at present prices; that it cannot afford the development work necessary to explore new fields, and that raising the price of such capital goods could not affect consumers other than in lower prices on finished products.

Price Line Bending

Doubtless as a result of this and similar presentations to Congress, Washington understands and agrees that OPA is now working under a smoke screen of hold-the-line publicity, while simultaneously effecting a strategic retreat to a more defensible price position. Word has gone out that OPA is conducting industry-wide studies in 45 fields with quick price-revision (doubtless upward) as the objective. Included in the group are the following of interest to this column: Machine tools, fractional horsepower motors, steel conduit, forgings, stampings, wire and cable, integral horsepower motors, steel mill rollers, mechanical power transmission, pulverized coal burners and industrial stokers (1200 pounds and over), industrial power boilers, boilers of 100 pounds per square inch of pressure (except oil country type and locomotive type), superheaters, economizers, shell and tube heat exchangers, air preheaters.

Firms in these fields, if contemplating applying individually for price adjustments, are being advised unofficially to save their time. It is considered highly possible that they may soon be excluded entirely from price control very shortly. OPA is reported to be finding the control of machinery prices a particularly burdensome one which, after all, does not appreciably affect cost-of-living figures.

Less officially, it is understood that Congress has sort of passed the word along to OPA that it had better do a bit of adjusting, and quickly, if it expects extension of its activities after June 30, present deadline for the agency. At the same time, the House has indicated, by extending the Second War Powers Act for one year, that it agrees with the principle of rationing, priorities and price control and will go along if certain improvements are made. House action to extend the act must now be approved by the Senate.

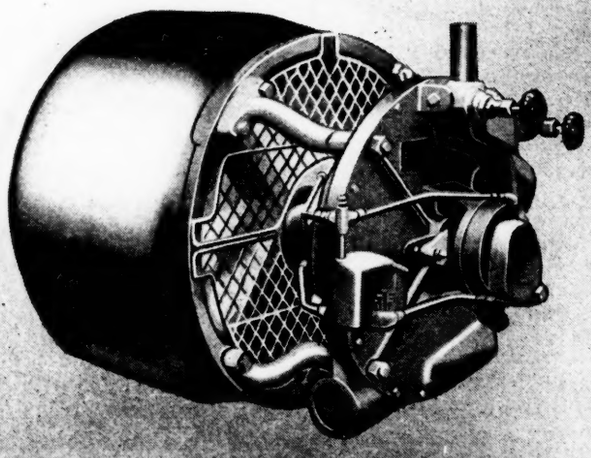
Building Ban

At press time, CPA had just issued a revised limitation order to channel scarce building materials into veterans' housing. Expected was an order placing construction under a permit system assigning priorities ratings for materials needed in authorized projects. Among expected provisions:

Low-cost housing to have major priority.

Completion of construction under way to be permitted—possibly without benefit of priorities.

WING



WING TURBINE DRIVEN BLOWERS

Type R

For Horizontal or Vertical Mounting on Wind Boxes or Air Ducts

Generally used for Oil Firing on Marine and Stationary Boilers, for Marine Ventilation, etc.

Ideal where use can be made of exhaust steam or where electricity is not available. Flexible capacity regulation by throttling steam to turbine—manually by hand valve or automatically by combustion control. Prompt shipments (no waiting for motors).

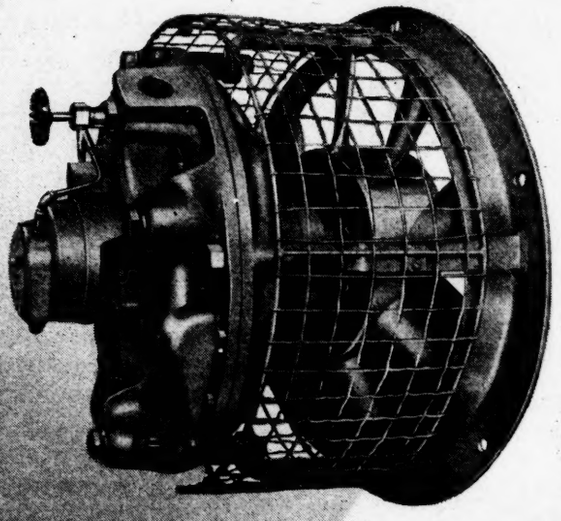
WING TURBINE DRIVEN BLOWERS

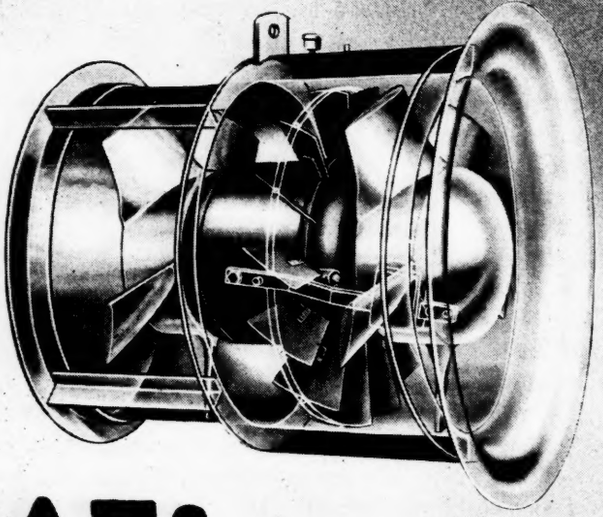
Type K

For Brickwall Mounting

Generally used for Stoker or Bagasse Firing where casing is cemented into Boiler Wall

Wing pioneered in forced-draft turbine blowers over a third of a century ago. Today Wing Turbine Blowers are in use in thousands of installations in many varied industries. They are simple and rugged in construction, quiet and dependable in operation. Oil-free exhaust can be used for heating, process or feed water.





WING MOTOR DRIVEN BLOWERS

TYPE COM (TWO STAGE)

TYPE EMD (SINGLE STAGE)

Wing Motor Driven Blowers are axial flow forced draft blowers of simple, rugged construction, compact design and highest efficiency. Type EMD has capacities up to 50,000 CFM with statics to 5". Type COM can handle statics up to 30" on special designs.

Write for Bulletin SW-1

L. J. Wing Mfg. Co.

154 W. 14th St., New York 11, N. Y.
Factories: Newark, N. J. and Montreal, Canada

Wing AXIAL FLOW BLOWERS

TURBINE BLOWERS

MOTOR DRIVEN BLOWERS

DRAFT INDUCERS

REVOLVING UNIT HEATERS

UTILITY HEATERS

FLOODLIGHT HEATERS

STEAM TURBINES

FOG ELIMINATORS

PROCESS HEATERS

VENTILATING FANS

EXHAUSTERS

SHIP VENTILATORS

Priorities probable for apartment projects offering units at $80 or less, and for hotels where needed.

Industrial construction to be cut back during the second quarter of 1946 to 90 percent of the first quarter; third quarter to be cut to 70 percent; fourth quarter to 35 percent.

Commercial construction to be cut to 90 percent, 70 and 30 respectively, compared with first quarter, 1946.

It was expected that office buildings would be given priorities if they could qualify as job-producers, and that factory construction would be favored, particularly if it would result in production of scarce items, especially building materials.

Proponents of the plan are hopeful it will be more effective than has Priorities Regulation 33 in channeling building materials into low-cost housing. Under this regulation, building material distributors have been required to hold a certain percentage of their inventories for 30 days, subject to requisitioning by holders of HH special ratings. Strangely enough (could it be by pre-arrangement?) builders suddenly find they don't need much material for low-cost housing, with the result that at the end of 30 days the dealer finds himself with plenty of material unclaimed by the HH'ers and therefore eligible for use in the taboo field above $10,000.

Oak Rafters?

Probably typical of what goes on in the housing field (and an example of what the veteran is up against), is a recent experience of this observer. Accompanying a GI to a "veterans' preference" project near Washington, a group of some 250 homes under construction and completed was inspected. Two-bedroom brick bungalows (with holes bored for two more in an unfinished attic) were offered at $10,900—$495 down and $65 a month. Noted first was the sketchy fit of doors and windows (without weather-stripping, of course)—then, believe it or not, rafters of oak, attic subfloors of gum and poplar! Builders were obviously using, in this loosely-fitted candidate for heat-loss prizes, any grade of lumber offered, regardless of price or grade—knowing the sales price would reflect current demand.

Stranger yet, there wasn't an unsold house on the plot print. Newcomers were signing up on the basis of fall delivery, "Probably at prices $1,000 higher—to reflect expected increases in building costs."

Congress Still Mulls

Even as the estimators estimate and the veterans clamor for shelter, Congress still mulls over the legislation regarded by the Administration as essential to the success of the program. The House, on March 7, passed and sent to the Senate a version of the Patman Bill—shorn by amendment of the Administration's plea for price ceilings on existing housing and for $600,000,000 in subsidies to stimulate production of building materials. As passed to the Senate, the bill provides:

1. For creation of a Housing Expeditor to coordinate housing policies.
2. Transfer to the Expeditor of powers now vested in the Office of War Mobilization and Reconversion, and continuance of these powers in effect after termination of the War Mobilization and Reconversion Act.
3. Establishment of ceiling prices on new housing, with the first sale price the maximum for later sales.
4. Authority for the Expeditor to forbid export of lumber.
5. Allocation and priorities for materials and special consideration for needs of farm buildings, moderately priced homes, and homes for veterans.
6. Liberalization of provisions of the National Housing Act relating to mortgage insurance.

Senate action on the bill is expected to follow settlement of the British loan question and the Vardaman nomination to the position on the Board of Governors of the Federal Reserve System. The Senate's own general housing bill, which includes a five-year slum-clearance program is also slated for consideration ahead of the Patman bill, but might be handled as an amendment to the Patman measure. An effort to return the subsidy item and the ceiling schedule for existing homes will also be made, further slowing passage, it is indicated.

Plant Equipment Outlook

Without making allowance for any curtailment of activity due to the housing program, American business, exclusive of agriculture, contemplates spending about $2.1 billion for new plants and equipment during the first quarter of 1946, the Department of Commerce and the Securities Exchange Commission have announced.

The estimate compared favorably with $1.9 billion for the last quarter of 1945, and $1.5 billion during the third quarter. If the anticipated expenditures actually occur, they would be at approximately the same annual rate as in the peak year of 1941, although total production would be actually less when adjustment is made in the price level.

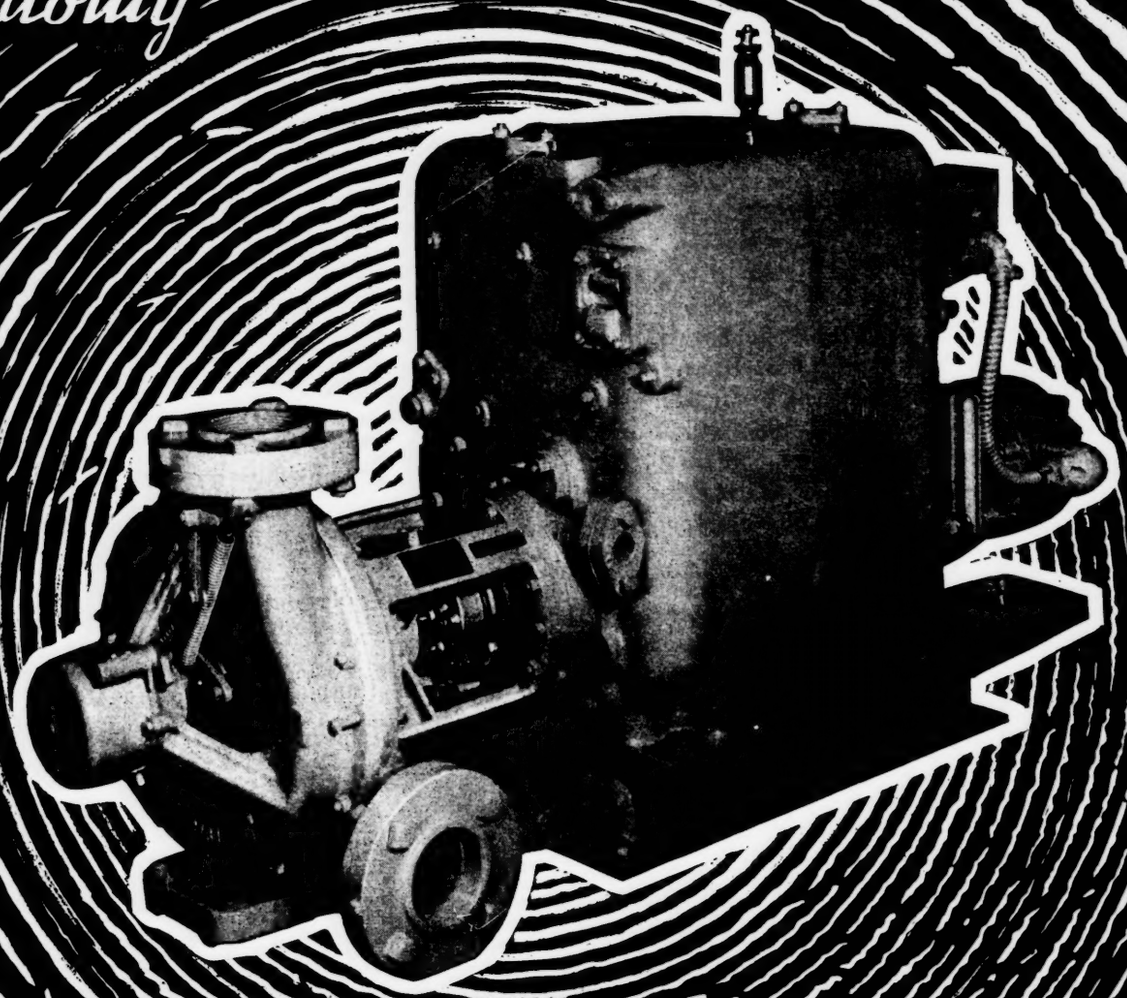
Distribution of the total is as follows: Manufacturing and mining, $1.31 billion; railroads, $.14 billion; electric and gas utilities, $.19 billion, and commercial and miscellaneous, $.45 billions.

Hospitals

Veterans' Hospitals will total 183 "permanents," having a capacity of 151,500 beds when the world's greatest hospital construction program, just launched by the Veterans' Administration, is completed at an estimated cost of $448,000,000.

There are now 98 Veterans' Administration hospitals in operation, with a total bed capacity of 83,339. In addition, the Veterans' Administration is taking over five Army hospitals with a bed capacity of 3,750. When the $448,000,000 program is completed, the Veterans' Administration will have 105 general medical and surgical hospitals, 49 neuropsychiatric and 29 tuberculosis hospitals. Three of these are under construction; funds are available for 47 others, and appropriations for 30 others are pending in Congress.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Design of Ice Skating Rinks

CHARLES H. HERTER

Brine coils being placed for the stage of the Center Theatre, Rockefeller Center, New York City.

Ice skating rinks have become important, profitable entertainment features. This article reviews the construction features of some rinks, analyzes operating expenses and financial return, and presents data of value to those interested in ice skating rink design.

FROM the time of the first ice skating rink in the United States in 1879, there has been a slow but steady growth in their number. It is expected because of the halt called in rink construction during the war years, and the increased popularity of ice rinks, that the coming years will show considerable activity in this field.

In years past, some ice rinks failed after a few years operation because of their then short season, as from October 15 to March 15, five months only. Modern rinks are air conditioned and have convertible floors so that the ice arena is adaptable for boxing, basketball, exhibitions, conventions, music festivals and dances. If the valuable experiences acquired with well-managed rinks is fully utilized, there is no reason why a first class ice rink and building should be less profitable than any other successful amusement enterprise. For obvious reasons thriving ice rinks are not in the habit of publishing their balance sheets.

Local conditions greatly influence the selection of a site for a rink if it is to be successful. An establishment of this type requires more planning by experienced men than would a standard theatre or an office building.

Dimensions of a Modern Rink

Let us consider a building containing a basement, and an exhibition hall with arched roof reaching to 75 ft above street level. The building would house an ice arena 90 $\times$ 200 ft (the minimum for hockey games is 85 $\times$ 190 ft) preferably with seating capacity for spectators at least along both the long sides of the rink. If the four corners of a 90 $\times$ 200 ft rink have 30 ft radius, the net effective skating area figures out 18,000 minus 772 or 17,228 sq ft. This is sufficient for 750 to 1000 skaters at one time. The perimeter of this size rink is 528 ft.

With stands 12 seats deep, the seating capacity theoretically becomes 3,800. However, we shall estimate the actual seating capacity at but 2/3 of this or 2,500. Allowing a depth of 40 ft on each long side of the rink for seats, and if no balcony is used, the total width of rink proper becomes $40 + 90 + 40 = 170$ ft. As the length is at least 220 ft, the total ground area = 37,400 sq ft. Many rinks are smaller than this, to the regret of their management.

Most of the basement space could be utilized for auto parking. If electric power is purchased from the local public utility the compressor and air conditioning rooms need not be larger than 1000 sq ft each, and the steam heating room, 1,200 sq ft. Oil firing is assumed, to economize on labor. To keep down costs, elevators should be avoided. The building must be of fire resistive construction, with numerous exits, so that in

case of fire, all occupants can leave the building within about five minutes. Since columns cannot be permitted in the skating space, a long span steel arched roof

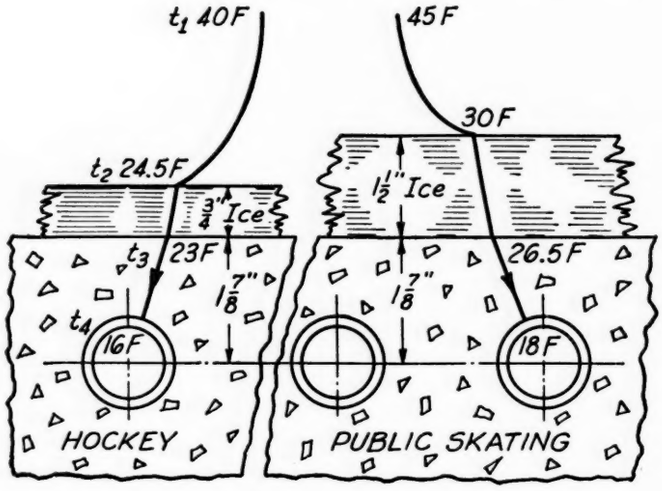


Fig. 1. Conditions for hockey and for general skating.

must be used. The estimated cost of building an enclosed rink and an estimate of the financial return follow:

Estimated Cost of an Enclosed City Ice Rink, 1946

Cost of ground, 40,000 sq ft at $2 per sq ft	$ 80,000
Cost of building, 200 × 170 × 50 ft high = 1,870,000 cu ft. At 35¢ per cu ft	654,500
Ice surface, 90 × 200 ft (net 17,228 sq ft) for 1,000 skaters. Cost of ice freezing machinery, rink floor, piping, insulation, air conditioning system	165,500
Construction fees	50,000
Incidentals	50,000
Initial Cost	$1,000,000

Estimated Average Cost of Operation

Skating sessions, two to three per day:	Full Day	Slack Day
Total receipts at box office:		
2,000 skaters at 85¢	$1,700	$ 850
2,000 spectators at 50¢	1,000	500
Income from lockers	100	50
Income from skate service	100	25
Sale of refreshments	400	200
Totals	$3,300	$1,625
Total cost of operation	1,250	1,000
Net income per day	$2,050	$ 625

To be conservative, figure $1,000 per day or $365,000 per year.

Income from parking space, neglected.

Expenses

Various taxes, social security, etc., 15% =	$ 55,000
Power, heat and lights	60,000
Salaries	10,000
Wages of instructors, guards, cleaners, etc.	20,000
Advertising and music	30,000
5% interest on $1,000,000	50,000
Depreciation, 5%	50,000
Total deductions	$275,000
Surplus per year	$ 90,000

equivalent to a return of 9% on the money invested.

This is the return and sum actually realized by a long established New York City rink having a net ice surface of but 14,200 sq ft and an available seating capacity for only 225 persons. There is every reason to believe that with modern equipment and capable management the return may reach 12%.

Main Constructive Features

Some ice rinks in Europe have been constructed at least partly open to the sky to keep down first cost. They were designed only for use in cold weather. On the other hand, in California where extra cost is no hindrance to pleasure seekers, such rinks are purposely provided with double-wall steel sheets which remain tight in any weather. Sufficient refrigeration is supplied to counteract the ice melting effect of California sun. However, these methods certainly are to be classed as extravagant and exceptional. Where the weather is changeable and rains occur often, as in American cities, common sense and economy demand that a skating rink be protected by a roof, thus making it possible to utilize the arena every day of the year.

Air Conditioning Necessary

In some rinks difficulty is experienced with fog over the ice sheet in humid weather. Builders made inadequate provisions for controlling the atmospheric condition in the rink. Dudley H. Scott by his 1913 patent initiated air conditioning in ice rinks. He aimed to soften the ice surface as desired for public skating, by mixing warm air with cool air until the air temperature above ice is 44F. It takes only five minutes to do this before the session starts. Then he again blows in 41F air. In his opinion, the normal rink temperature should be 50F; higher temperatures demand more refrigeration. This cool temperature is satisfactory for active skaters, but inactive spectators prefer a temperature at least 20F higher. This may be supplied by air from unit heaters located above the spectators' heads, although modern controlled concealed floor radiation or panel heating would be a better solution.

In the average rinks, where radiators are hung from the outside walls, a third of the heat is lost through the cold unprotected walls, one-third rises straight up in a column of hot air, and only the remaining third does useful room heating. The air drying effect is 100% because no effort is made to keep up a healthful condition by means of humidifiers.

All outer walls and the roof should be heat insulated to a reasonable extent. In fact, the entire ice rink should be treated as a big refrigerator. The exterior should be smooth and painted white so as to reflect heat rays. Since the usual skylight with single panes acts as a moisture condenser in winter and supplies objectionable heat in the summer, such design should not be used.

Moist air being lighter per cubic foot than dry air, good design demands the use of ample roof ventilators, each equipped with variable speed fan motors and capable of collectively exhausting all rink air once every five minutes, without undue noise. Fresh air is filtered, and is either heated or cooled as may be

necessary. It is then introduced above the rink level.

Influence of Air Upon Condition of Ice Surface

Since in hockey games only a small but very active number of skaters is present, the ice surface should be harder than for public skating, and its temperature must be about five degrees colder. Also there is no need for ice thicker than ¾ in. To meet this condition let us assume a mean brine temperature of 16F, and an air temperature of 40F, 24 in. above the ice. The refrigeration then required per hour per square foot of ice surface can be closely approximated as follows: and from this the temperature gradient found from air to brine. The results are shown in Fig. 1. The factors are written in sequence with the heat flow from air to brine in the floor pipes. Thus, the heat flow per degree difference equals:

$$U = \frac{1}{\left(1/2 + \frac{0.75}{15.9} + \frac{1.875}{8.30}\right)} = \frac{1}{0.7732} = 1.2935 \text{ Btu}$$

per degree.

$$1.2935\ (40 - 16\text{F}) = 31 \text{ Btu per sq ft per hr.}$$

In this formula 0.75 is the ice thickness in inches and 1.875 the thickness in inches from the rink surface to the center line of the pipe; k is 15.9 for the condition of ice in the problem and is 8.30 for concrete.

The ice surface temperature

$$t_2 = 40 - 31/2 = 24.5\text{F}$$
$$t_3 = 24.5 - (31 \div 15.9/0.75) = 23\text{F}$$
$$t_4 = 23 - (31 \div 8.3/1.875) = 16\text{F}$$

In public skating the skaters prefer a softer ice surface which offers least amount of resistance. For the moment, the ice groove melts under skate pressure, but freezes up again shortly. Also the body heat introduced by many skaters tends to melt the ice. To guard against this a greater thickness of ice was found advisable, such as 1½ in. for a reserve. The softer ice requires a higher surface temperature, say 30F.

Fig. 1 illustrates also the temperature gradient preferred for public skating in an indoor rink. As before, the refrigeration may be calculated:

$$U = \frac{1}{\left(1/2.5 + \frac{1.5}{16} + \frac{1.875}{8.30}\right)} = \frac{1}{0.71975} = 1.388 \text{ Btu}$$

per degree.

$$1.388\ (45 - 18\text{F}) = 37.47 \text{ Btu per sq ft per hr}$$

Now the ice surface temperature

$$t_2 = 45 - (37.47/2.5) = 30\text{F}$$
$$t_3 = 30 - (37.47 \div 16/1.5) = 26.5\text{F}$$
$$t_4 = 26.5 - (37.47 \div 8.3/1.875) = 18\text{F}$$

By means of an ice control system which includes a control room equipped with all necessary instruments, the ice control man is in position to supply colder brine if needed, or to introduce either warm or cool air into the rink to temper the ice. This economizes on refrigeration while maintaining the ice surface in the condition desired, and at least possible cost. Where the engineer can control merely the brine temperature and neither the air nor ventilation, it is not possible to achieve the ideal conditions desired. In the latter case, heat can only be abstracted by the cold brine below the ice, but to soften the ice at top, heat has to be supplied by air above the ice.

Heat Conductivity of Ice

Jakob and Erk of the German Bureau of Standards in 1929 published the results of accurate tests made to

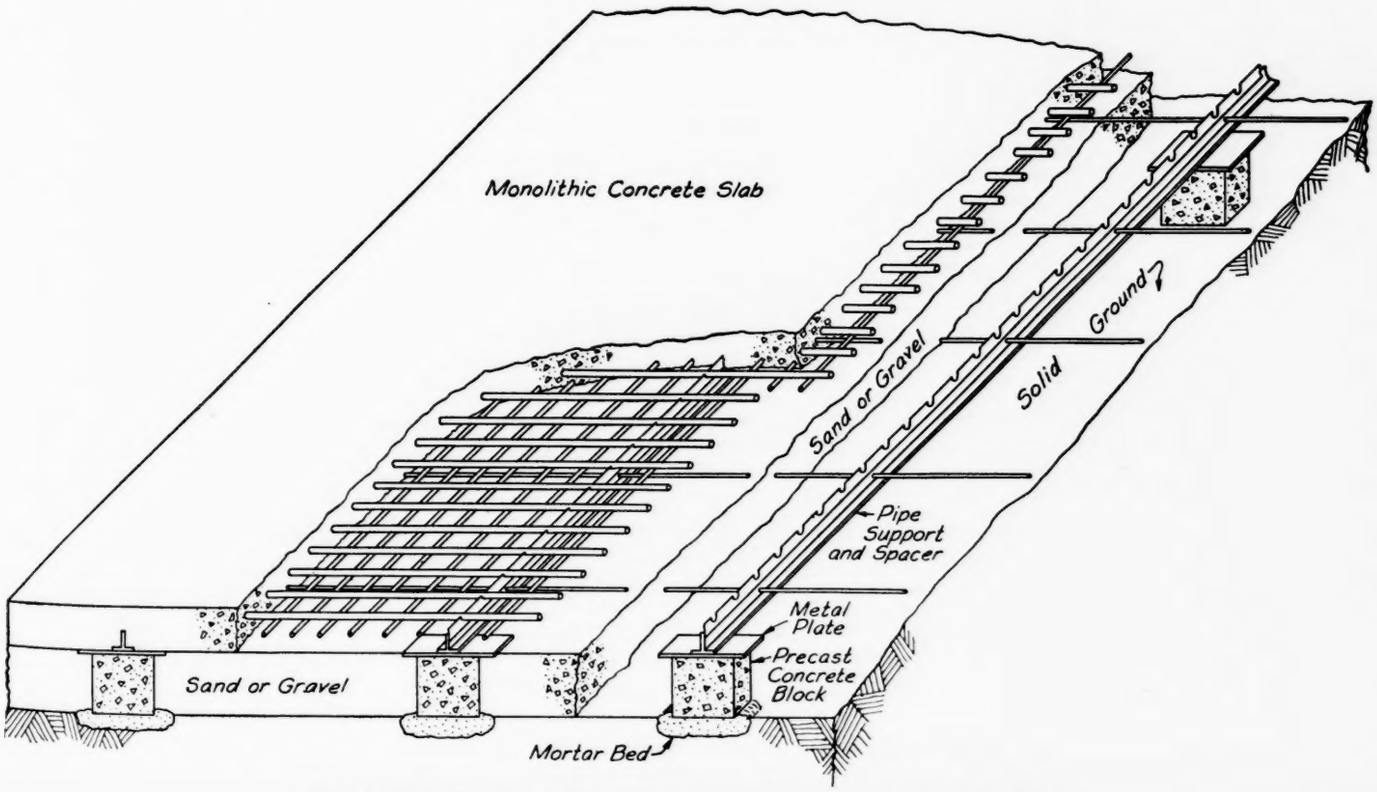


Fig. 2. Details of the Carpenter monolithic concrete floating floor.

determine the heat conductivity k in Btu per hr per sq ft per in. per F of clear water ice. These results, translated to our English system of measurement, follow:

Temp. F	32	14	—4	—22	—40
k =	15.49	16.20	16.92	17.66	18.46

The value for 32F given in the ASRE Data Book, also in Kent's Mechanical Engineer's Handbook is 15 Btu.

Transparent Insulation

Only as many windows (preferably in cool walls) should be used as are needed for ventilation. These windows should have triple glass. This transparent insulation may be built of several sheets of glass, Thermopane, or flat sheets of acetate cellulose like cellophane with thin air spaces between.

Rink Floor Construction

The most important feature in any rink is the floor. Many styles of floor construction have been tried. While some use direct expansion of liquid refrigerant, the majority favor calcium chloride brine since it is easier to control, particularly where ice skating is intermittent and the ice has to be removed or peeled off within a few hours. This peeling-off can be done by withdrawing the cold brine in the system and pumping through heated brine. While another method is to spray hot water on the ice, it requires more time and labor. The forced method of thawing was first used in the new Madison Square Garden, New York City. Automatic venting of air from pipes becomes essential.

Heat for brine warming should be obtained from the hot compressor exhaust by passing the hot gas through coils in the brine heating tank. The snow and ice removed after each session can be utilized for condensing refrigerant vapor or for precooling the condensed liquid. Of course, a large insulated brine cooling tank is required for holding the brine pumped from the rink piping. In practice this brine temperature is lowered below the normal 18F; thus the refrigerating effect is stored up for the next session.

An efficient and compact method for brine cooling is the use of herringbone type evaporating coils with flooded feed system as used in modern can ice-making plants. Such coils are located directly in the cold brine tank, possibly with agitating propellers. A separate tank and heat exchanger is necessary for heating the ice melting brine.

In some rinks costly steam is applied to melting ice and snow, and no effort is made to utilize the available refrigeration for liquid precooling. Modern rink economy demands that every opportunity be taken for conserving refrigeration and heat by utilizing heat exchangers to the fullest extent.

In the past, engineers have employed various methods of rink floor construction. For many years the Elysium Rink, Cleveland, Ohio, simply had brine pipes lying on a deep bed of sand. This foundation remained frozen all through the winter and the refrigerating machines absorbed such ground heat as might then exist. The ice surface measures 86 × 240 ft. It was here that M. R. Carpenter in 1917 installed his first monolithic concrete floor.

A temporary ice carnival rink of 7,400 sq ft used only in the summer of 1940 in the Municipal Auditorium, New Orleans, La., consisted of a 24-gauge galvanized steel pan resting on two layers of 1-in. Celotex and tarred felts. It had 29,120 ft of ⅝-in. OD type L hard drawn copper tubing spaced 3 in. between centers. Two 60-hp, 37-ton Freon compressors supplied direct expansion refrigeration.

Details of Rink Floors

Ice rinks which are expected to be used at least during eleven months per year must have a properly insulated floor to reduce heat inflow to a minimum. A 4-in. thickness of first class insulation is satisfactory. Great care is necessary to make the waterproofing permanently effective.

The rink of the University of Illinois, Urbana, Ill., 126 × 194 ft with 24,099 sq ft of ice surface, was first built in 1931. Brine leaks developed 3 years later. In the fall of 1937 it became necessary to renew the entire floor because over one-third of the pipes were out of service. The rink was reopened Feb. 1, 1938.

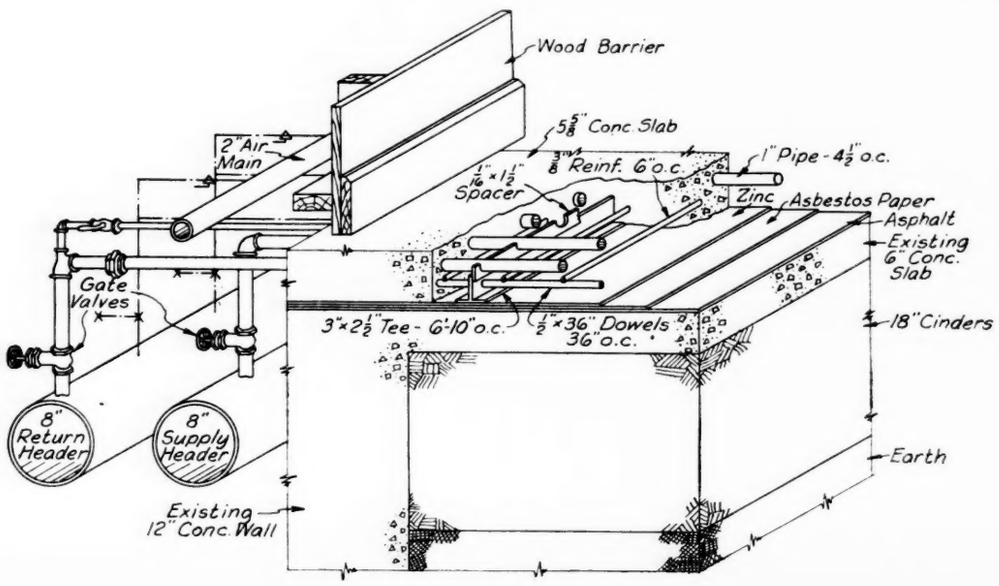


Fig. 3. Details of the new floor, University of Illinois ice skating rink.

The total cost of this job, including royalty on the Carpenter patent, was $26,444.47 or $1.097 per sq ft.

Carpenter's plan required a distinct separation of the new 5⅝-in. thick finished monolithic concrete floor from the old 6-in. concrete sub floor so as to permit the upper floor freedom to expand in every direction. If we figure a possible 70F rise in temperature of this concrete slab, the expansion in 100 ft would be $0.000008 \times 100 \times 70 = 0.056$ ft = about 11/16 in.

Separation is effected by giving the 6-in. sub floor a coat of concrete primer, after careful leveling, then covering this with a layer of 12-lb unsaturated asbestos paper with hot asphalt at under side only. Talcum powder is then dusted over the asbestos to reduce the friction between the two slabs. At Urbana, Ill., no heat insulation appears to have been used, because only winter use was expected. However, the use of 4-in. of good board form insulation set first in hot asphalt on top of the 6-in. sub slab would be an improvement.

On the smooth asbestos paper comes a layer of No. 5 sheet zinc (0.010-in. thick, 0.37 lb per sq ft) laid with staggered joints, lapped one inch, and soldered. Next is placed steel T bars 2½ × 3-in. high, 6.1 lb per ft, laid in this case 82-in. on centers, the length of the rink. The ends are bolted with fish plates. Through the stems of the T's run ½-in. dia. by 36-in. long dowel rods, 36-in. on centers, to bond together the adjacent sections of concrete that are divided by the T bars. To space the one-inch brine pipes exactly 4½-in. on centers, to suit the old headers, it was thought necessary to spot weld steel plates 1/16 × 1½-in. high along the top edge of T bars, notched half round to fit the pipes.

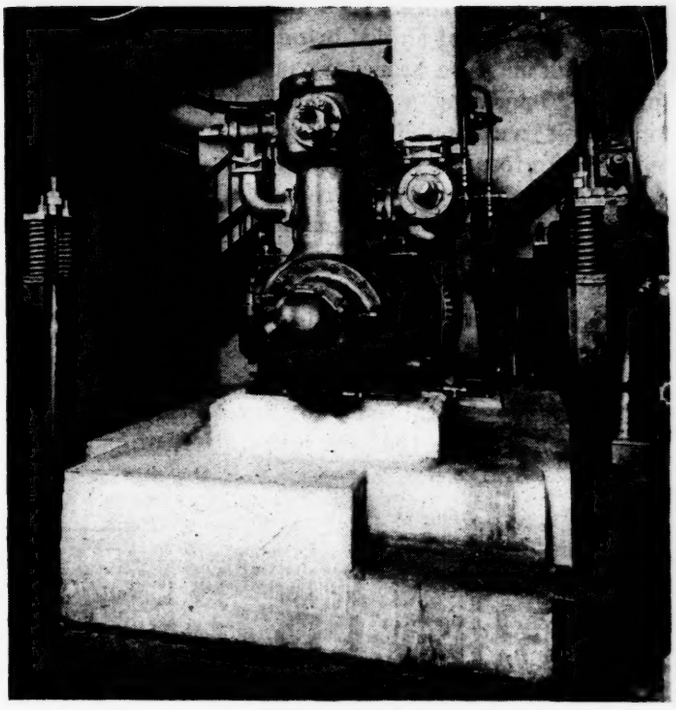
Directly beneath the pipes, at right angle, are steel reinforcing bars or rods 8-in. on centers, wired to the pipes. One-half inch rods are used in the central portion of rink and ⅜-in. rods in the rounded-off end portions. The new pipes are 1-in. standard weight butt-welded steel pipes furnished in 42 ft lengths, ends beveled for welding. Hairpin return bends of 1-in. extra strong seamless steel pipe were used. A total length of 64,059 ft of floor piping was used and 1,548 field welds were made.

Plastic Floor Pipes Not Suitable

The writer investigated the possible use of a new plastic tubing to avoid possible leaks in rink brine pipes. For at least two good reasons this plastic piping is not suitable. Its heat conductivity k is 0.638 Btu per sq ft per hr per in. per F as against 310 Btu for steel with 1% carbon, or a ratio of 1 to 486. The coefficient of expansion is 0.000878 per F as against 0.00000608 for soft steel, a ratio of 144 to 1.

Iron and Steel Pipes

At Urbana no pronounced difference in durability could be ascertained between standard weight black steel and wrought iron pipe, nor between welded and threaded joints. Since failure usually starts at points where the pipe projects from the protective concrete, it is advisable to use spellerized pipe, scale-free inside and out, with no protective coating of any kind, and



Vilter Freon compressor used with a brine system for the stage of the Center Theatre.

to rely solely on a homogeneous dense mixture of concrete made of rapid hardening cement, torpedo sand, and crushed limestone. No cinders should be used. A mixture ratio of 1 : 2.56 : 3.05, or in pounds per cubic foot: 21.9 lb cement, 56.0 lb sand and 66.7 lb stone, yielded maximum density and minimum shrinkage. Average compression strength after 28 days was 5,040 lb per sq in.

It is very important to treat the brine flowing through the pipes with sodium dichromate as recommended by the ASRE to inhibit a tendency to internal corrosion. The pH of the brine should be kept between 7.5 and 8.0.

Refrigerating Capacity Required

In practice, the least machine capacity required is where the rink is used during winter only. Then one ton of refrigeration (12,000 Btu per hour) is sufficient for maintaining 340 sq ft of ice surface. At starting and during warm weather two machines are regularly provided, representing an available capacity of one ton per 170 sq ft. Where it is desired to produce a frozen floor within 12 or fewer hours as at the Olympia Arena, Detroit, which has a net floor area of 24,258 sq ft and uses three 90-ton Frick compressors, we have one ton capacity for each 90 sq ft ice surface. In the latter case it is necessary to have a strictly level surface so that not over one inch of ice has to be formed. It would be rational to likewise increase the floor pipe surface using at least 1-in. standard weight pipes (or extra strong) on 3-in. centers or closer.

Opportunities for Heat Exchangers

Air conditioning with its widely varying demands for capacity further complicates the problem of econom-

ical rink engineering. In a modern plant, refrigeration in the form of chilled brine or partly frozen water in a tank may be stored up, thus keeping the compressors operating with a high load factor. When operating with public utility current the engineer should aim to utilize but not exceed a definite quantity of current, and not to overrun a definite demand each week. Also during winter months a large user is not to draw more than 20% of current between the hours of 4 to 8 p.m. when the power stations have to carry full lighting load. Such conditions of operation make it necessary to anticipate demands and to resort to unloading devices (clearance pockets) on compressors and to employ several units for flexibility.

It is conceivable that the generation of power, as with diesel oil engines, with accompanying possibilities of utilizing exhaust heat and jacket water heat, is probably most rational for an ice rink to escape inconvenient load restrictions. The successful 14,200 sq ft New York ice rink previously mentioned uses a steam electric set in winter to gain exhaust steam needed for heating. The high pressure boiler is oil fired and uses a diesel-electric generating set during the remaining months. The recooling of city condenser water and engine jacket water is also included.

If a rink were suitably heat insulated, enough heat for space heating might be recovered from diesel engines, compressors, lights, and from a good-sized audience, thus dispensing with boiler, stack and steam engine.

Graphical Determination of Heat Transfer Film Coefficient for Liquid Freon-21*

B. F. RABER** and F. W. HUTCHINSON***

THE graphical solutions presented in this installment of the heat transfer series are constructed in the same way as those which have previously appeared.[1] Values of the convective film coefficient obtainable from the graphs are as accurate as the basic exponential equation from which the graphs have been constructed; in the year and a half since this series started no further evidence has been uncovered to justify the belief that any other form of general heat transfer film coefficient relationship can be developed which will exceed in accuracy the exponential heating and cooling equations which relate Reynolds', Nusselt's, and Stanton's Numbers.

The film coefficients obtainable from the graphs are for *liquid* refrigerant heating or cooling when flowing inside a pipe, or outside and normal to a single pipe; the coefficients do not, of course, apply to liquid during a heat transfer process in which either evaporation or condensation takes place. In subsequent articles the coefficients for evaporation and condensation and for refrigerants in vapor form will be presented.

Fig. 13, for liquid F-21 inside a pipe, differs somewhat from previous graphs due to the fact that with this refrigerant the influence of temperature on the numerical value of the film coefficient is negligible in the range from 0F to 100F. The coefficient is, however, affected by the process—whether heating or cooling—and it is therefore necessary to use two different scales depending on whether heat is being added to or removed from the liquid.

Fig. 14, for liquid Freon-21 outside a pipe, shows the influence of temperature on the film coefficient, but in this case there is no difference between the coefficients for heating and for cooling.

Example: Consider the heat transfer through one square foot of surface of a pipe having negligble wall thickness, negligible wall resistance, and 1½ in. diameter. Liquid Freon-21 is flowing within the pipe at a rate of 5½ ft per sec and is losing heat from an average temperature of 100F to liquid Freon-21 which is flowing normal to the outside of the pipe with a velocity of 4 ft per sec average temperature of 75F.

Solution: Enter Fig. 13 at 5½ ft per sec (see dashed line on figure) and rise vertically to intersect the horizontal for 1½ in. outside diameter then follow the directrix lines up to the lower scale and from here rise vertically to intersection with the scale for fluid *cooling* where read the film coefficient as 375 Btu per hr per sq ft per degree temperature difference. Similarly, enter Fig. 14 at 4 ft per sec, rise to the 1½ in. diameter horizontal, follow the directrix to the scale, rise vertically to the horizontal line marked 75F then follow the directrix back to the scale where read the film coefficient as 265 Btu per hr per sq ft per degree temperature difference.

The sum of the thermal resistances of the two films is then, $(1/375) + (1/265) = .0027 + .0038 = .0065$, so the overall coefficient of heat transfer is $1/.0065 = 154$ Btu per hr per sq ft per degree temperature difference. The difference between the two fluids is 25F so that the rate of heat transfer is $154 \times 25 = 3{,}850$ Btu per hr per sq ft.

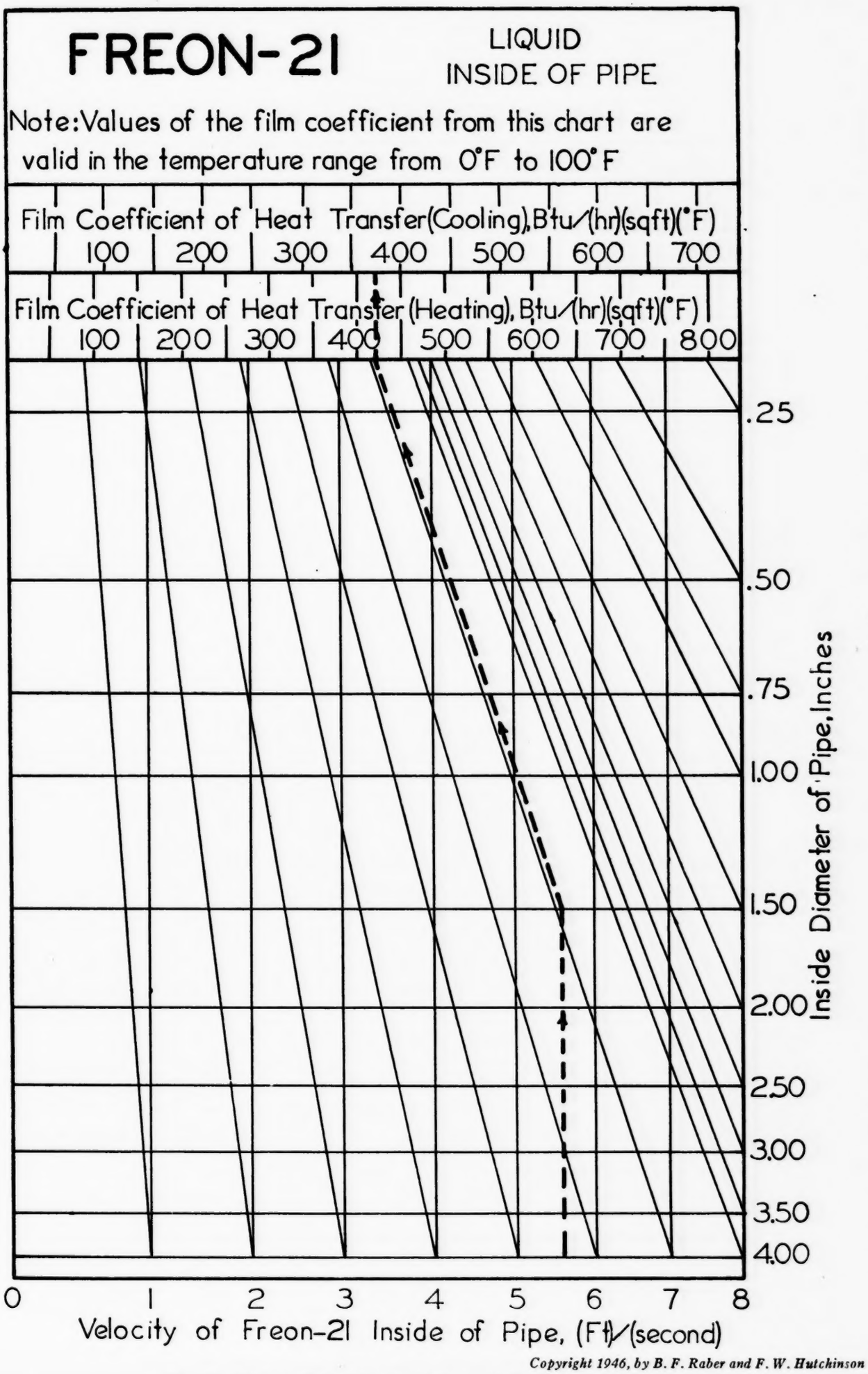
---

*Freon is a copyrighted trade name held by the Kinetic Chemical Co.

**Professor of Mechanical Engineering and Chairman, Division of Mechanical Engineering, University of California, Berkeley, Cal.

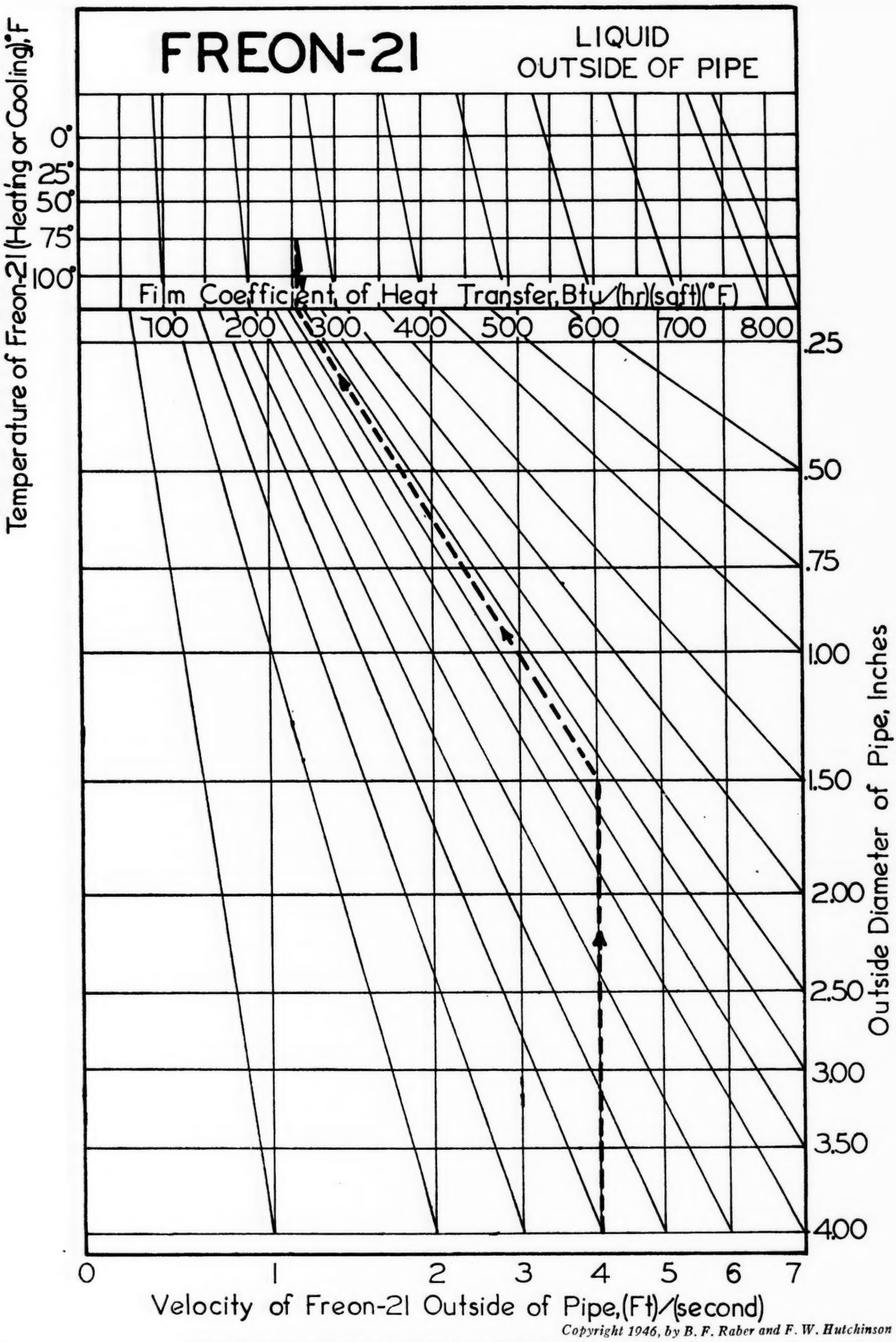
***Professor of Mechanical Engineering, Purdue University, Lafayette, Indiana.

[1]Fluids previously covered are: water, ammonia, sulfur dioxide, brine, Freon-12, and Freon-11, in the Dec. 1944, Jan. 1945, Feb. 1945, Mar. 1945, April 1945, and June 1945 issues, respectively, of HEATING AND VENTILATING.


FREON-21
LIQUID
INSIDE OF PIPE
Note: Values of the film coefficient from this chart are valid in the temperature range from 0°F to 100°F
Film Coefficient of Heat Transfer (Cooling), Btu/(hr)(sqft)(°F)
100 200 300 400 500 600 700
Film Coefficient of Heat Transfer (Heating), Btu/(hr)(sqft)(°F)
100 200 300 400 500 600 700 800
.25
.50
.75
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Inside Diameter of Pipe, Inches
0 1 2 3 4 5 6 7 8
Velocity of Freon-21 Inside of Pipe, (Ft)/(second)

Copyright 1946, by B. F. Raber and F. W. Hutchinson

Fig. 13. Film coefficient for liquid Freon-21 flowing inside a pipe.



Copyright 1946, by B. F. Raber and F. W. Hutchinson

Fig. 14. Film coefficient for liquid Freon-21 flowing outside a pipe.

Make-Up Air

T. W. REYNOLDS

ALL too frequently make-up air is dumped into an industrial space in a more or less haphazard fashion. Were it air for ventilating purposes, the air would no doubt be nicely distributed through numerous outlets of a good diffusion type, but designate it as "make-up" air and its importance is degraded. All that then comes to mind is a unit combining an outdoor air intake with a fan and heater connected to a single discharge grille.

There is, however, more to it than that, as will be seen by looking at Fig. 1 where 8000 cfm (or 70 air changes) is required in the paint shop as make-up air for the spray booth. You just can't put that quantity of air in such a space at a single point. Even with the best diffusion there are some complaints from the workers as to drafts.

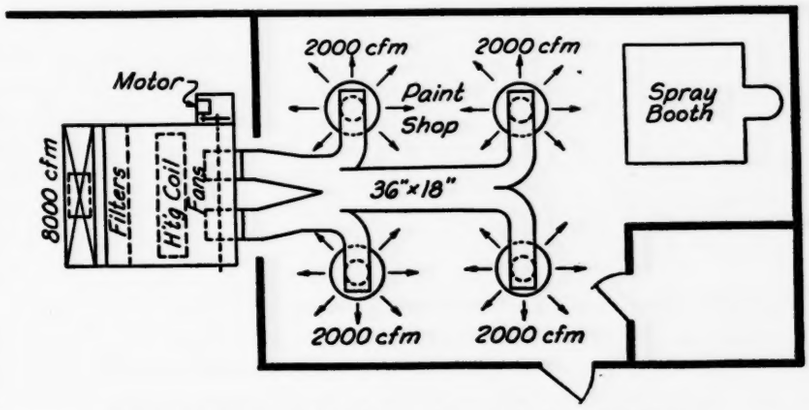


Fig. 1. Unit ventilator for make-up air in paint shop.

Make-up to a paint shop must exceed the exhaust by an amount which will pressurize the space up to a point where dust from adjacent areas will be prevented from entering, yet not so much pressure that the odor of paint is driven out to these other areas. It is because of such conditions that the quantity of make-up air required quite often approaches the impossible.

A wood-working shop is relatively not so bad. Here the air should likewise slightly exceed the air exhausted, in this case just enough to offset any tendency for undue infiltration of cold air into the space. The unit in Fig. 2 has a capacity of 5000 cfm, or 14 air changes for the space served.

Here, again, air diffusers are advisable, though their introduction at the ceiling was not without difficulties in the case shown. There are many services in an industrial plant (heating and process pipes, sprinkler heads and exhaust ducts) and they are placed at the ceiling. As if this were not enough, practically all of the space then left at the ceiling is taken up by lighting equipment. When this lighting is fluorescent and staggered it becomes a jig saw puzzle as to how to clear steel, especially with roof openings, for outdoor air intake. How to run a duct in the space that is left without continually changing direction to clear this and that and how far off centers the air diffusers can be and yet distribute the air becomes a major problem.

Such conflicts necessitated the installation of the wood working unit in an adjacent space and the use of a unit having a single fan and outlet. Some forget that where a unit has two fans with two outlets it must have these outlets twinned together, as shown in Fig. 1, and not separately piped to the air outlets. The static pressure of each run may not be equal or the construction may not be alike, and even when it is equal, someone may throttle or completely close off some outlet with a piece of cardboard. The fan shaft of these units is not built for inequalities or unequal torsion.

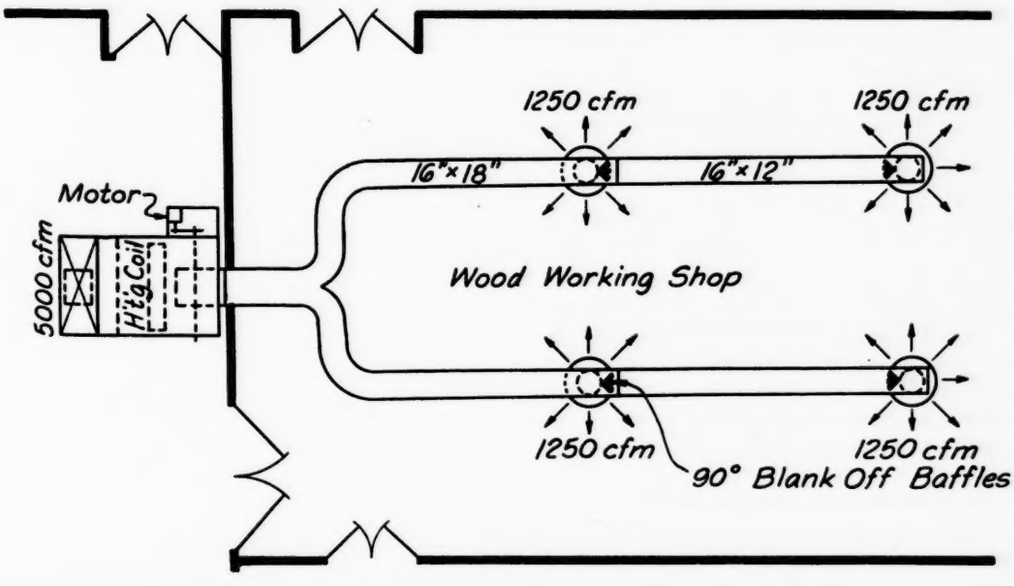


Fig. 2. Unit ventilator for make-up air in wood working shop.

Inasmuch as the air is for make-up, the units must run continuously while there is exhaust. A modulating steam valve with a ductstat will be the form of temperature control, unless there are condensate lifts to overhead returns, in which case the control must be by face and by-pass dampers at the heating coils, rather than by modulation of the steam valves. The air should be introduced at around 85F to

make its presence less evident with such a large air movement. Heating to 75F might be sufficient, except that the outdoor air can at times drop at least 10F below design temperatures.

There is a lag in heat storage of building structures to tide over sudden and brief drops in outdoor temperature, but there is no lag in the temperature of outdoor air when introduced through a ventilating unit. It is definitely cold air. During the war, its chill was experienced in wartime plants in California and in other places where direct heating by radiators was normally not required, nor allowed due to conservation of materials, especially where there was some process heat. It was found, however, that in the case of outdoor ventilation air mechanically supplied, heating of this air was definitely necessary unless introduced at very high levels or points remote from the occupied zone, or the fan capacity greatly increased so that the fan discharge temperature could be tempered with recirculated air. If the low outdoor temperatures continue for too long a time, even this last method will not be the answer. This is due to the great quantity of internal heat absorbed in warming low temperature air of such magnitude in quantity. This air is finally lost to the outdoors by way of the exhausts and the heat carried away in this manner must be compensated for by heating the incoming air.

Fig. 3 shows a blackout type of winter supply ventilator taking outdoor air from the roof as in the other sketches, but discharged through a single circular air diffuser. This unit requires no duct work and is satisfactory where filters are not required, as in the wood working shop, and it is felt that one diffuser will discharge the air into the space without objectionable drafts. It was not used in the case shown, because there would have been insufficient head room below the unit. The heating coil, like those in the unit ventilators, should be of the non-freeze type and a room thermostat must be located near the leaving air of the unit. Motor and starter for any of these units if installed in the paint shop should, of course, be explosion proof.

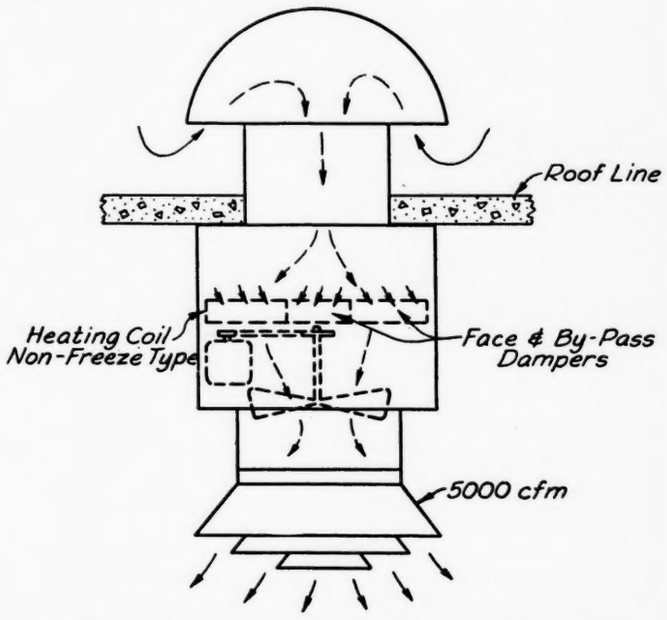


Fig. 3. Winter supply roof ventilator, blackout type.

Diffusers of all the units shown should be equipped with dampers for regulation and equalization of air discharged over the diffuser face. If more than ventilation is required, various forms of control may be used. A separate unit heater may take care of the heat losses from exposed surfaces where there is insufficient process heat for this purpose, or all of the heating may be combined with the ventilator and the unit heater omitted, or the ventilator may furnish part of the heat losses where the existing heating system is inadequate, or wherever a quick pick-up of the heating of occupied areas is desirable.

Marine Air Conditioning Expands

A rapidly widening market on the high seas for air conditioning and refrigeration equipment is indicated by Carrier Corporation's recent installation of year-round air conditioning equipment in nine new cargo-passenger vessels of the Grace Line.

Many shipping executives feel that trans-ocean travelers to whom speed is paramount will fly, and that the consequent discounting of the speed advantage held by the large luxury liners will result in a general stepping-up of passenger conveniences on smaller cargo-passenger vessels. Several shipping lines are said to believe that their smaller ships can furnish as much comfort and luxury to ocean voyagers as the larger "de luxe" liners.

For this reason, the Grace Line's move in air conditioning the nine ships is regarded in maritime circles as extremely significant.

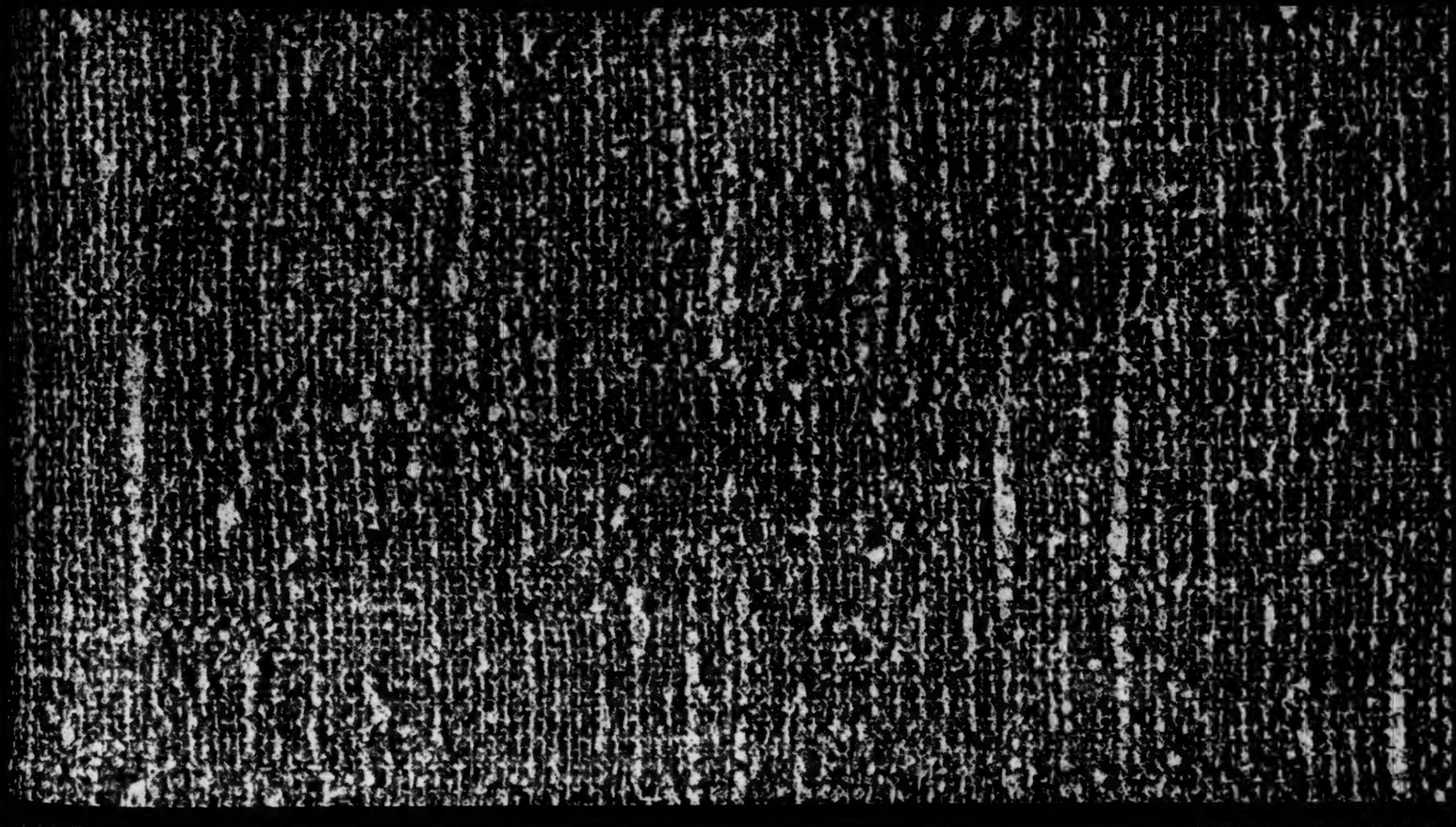
The vessels, Maritime Commission long-range C-2 type, will operate between East Coast ports and the west coast of South America. Using Carrier's conventional re-circulation system, each ship will have three independent systems: one for the club lounge, bar and dining salon; one for the crew's mess and the petty officers' mess; one for the 29 first-class staterooms, the officers' quarters, the captain's quarters and the barber shop.

Each vessel is provided with three small cargo compartments totalling 5,300 cu ft gross volume arranged for temperatures of 0F, and four large cargo compartments totalling approximately 120,000 cu ft gross volume, designed primarily for transportation of bananas. These large cargo compartments are provided with special controls for accurately maintaining the delivery air temperature. There are a total of five compressors, one for each compartment and the fifth compressor being a complete spare at all times. The control of the plant is completely automatic, both as to operation of the compressors and temperature control in the various compartments.

UNIT HEATERS

Steam and Hot Water Types

J. E. YORK
Building Service Engineer
Stone & Webster Engineering Corp.



HEATING AND VENTILATING'S REFERENCE SECTION

Unit Heaters
Steam and Hot Water Types

J. E. YORK
Building Service Engineer, Stone & Webster Engineering Corp.

The author classifies the various types of units, then discusses details of construction of headers, heating surface and fans, and suggests some phases of specifications for unit heaters. The objective is not to cover these matters in an encyclopedic manner but to give a reasonably comprehensive picture of the present day steam (or water) unit heater which has won an undisputed place in heating engineering.

UNIT heaters are designed to provide:

1. Fast even heating with least stratification;
2. Simple and reliable control of the heat output to suit the demand;
3. Economy of operation, and
4. Low first cost.

Unit heaters are giving satisfactory and dependable service in a wide range of installations in manufacturing plants, garages, laundries, dance halls, stores, waiting rooms, cafeterias, factory offices, theatres and other types of buildings. They are especially suited for buildings with high ceilings or with large roof areas or where there are large doorways which must be frequently opened during cold weather.

Installation of unit heaters is not recommended in residences or small offices or in church auditoriums, library reading rooms, lodge rooms, studios of broadcasting stations, etc., where noise levels of 30 decibels or less are desired, and unit heaters of the steam or water type cannot be installed in buildings without electric service or where some central source of steam or hot water is not available. Unit heaters should not be installed where air currents are objectionable, or where there are inflammable or explosive fumes or large concentrations of dust, unless explosion-proof motors and controls and spark-proof fan wheels are provided.

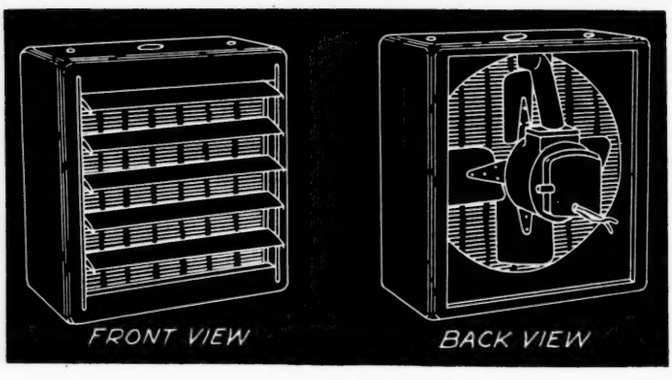


Fig. 1. Front and back of a standard propeller type unit heater.

PRINCIPAL TYPES

Steam (or water) unit heaters may be divided into three principal types:

1. Standard propeller type unit with horizontal air stream;

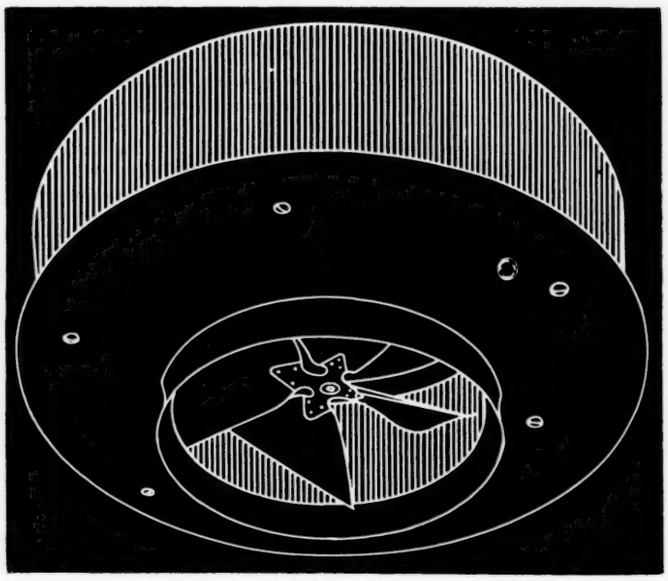


Fig. 2. A typical projection (downward flow) type unit heater.

2. Projection type with vertical downward air stream; and
3. Blower type.

The standard propeller type unit heater is manufactured in a wide range of capacities from 20,000 Btu to 275,000 Btu per hour, and for use with steam from 2 lb to 150 lb pressure or with hot water. It is generally suspended overhead but may, in some cases, be mounted on a recirculation box. Outlet velocities range from 500 to 1,200 fpm. The sound rating in decibels ranges from 45 to 75. The motor horsepowers vary from 1/40 to ½ hp with an input of 80 to 600 watts. A typical unit heater of this type is shown in Fig. 1.

The projection type unit heater, Fig. 2, is a propeller type unit arranged to draw air through the

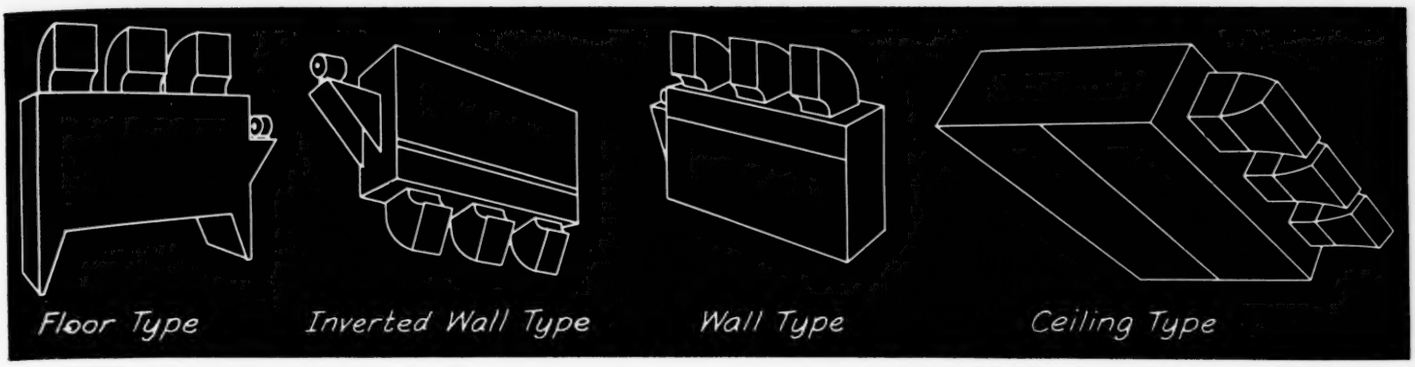


Fig. 3. Four arrangements of blower type unit heaters.

heating surface and to discharge downward. This type unit is also made in a wide range of capacities from 24,000 Btu to 600,000 Btu per hour; for use with steam from 2 to 150 lb pressure or with hot water. This unit is designed for suspension overhead and has outlet velocities from 200 to 2,600 fpm. The sound rating in decibels ranges from 50 to 80. Motor horsepowers vary from 1/40 to 2 hp with an input of 80 to 1,920 watts.

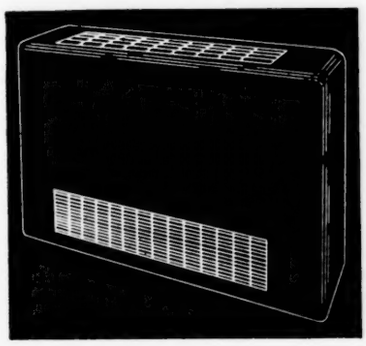


Fig. 4. Convector type unit heater.

The blower type unit heater can be obtained for floor mounting, horizontal overhead suspension, or for mounting on a wall in either upright or inverted position, as in Fig. 3. It is equipped with one or more housed-type fans mounted on a common shaft, direct connected or through V-belt drive to a single motor. Each fan is provided with a separate discharge outlet but one common heating unit supplies heated air to all of the fans. This type of unit is manufactured in capacities ranging from 100,000 to 2,000,000 Btu per hour and for use with steam from 2 lb to 150 lb pressure, or with hot water. Outlet velocities range from 1,300 to 3,000 fpm. The sound ratings in decibels range from 35 to 70. Motor horsepower varies from ¼ to 5 hp with input from 800 to 4,800 watts.

Forced flow convector type unit heaters, Fig. 4, are a special form of the blower type units. They are equipped with quiet housed-type fans and are usually furnished with cabinet type casings having inlet grille at the front near the floor, and a single discharge grille in the upper horizontal surface, or at the top of the front surface. These units are manufactured in three models: floor, wall and horizontal suspended type with capacities from 20,000 to 100,000 Btu per hour. They are adapted for use in lobbies or other locations subject to drafty conditions and where the type of construction used in the regular blower units would not be suitable.

SELECTION OF UNIT HEATERS

For large areas, there is a material saving in first cost by reducing the number of units, with consequent reduction in length of pipe, number of valves, traps, thermostatic control units, and the decreased amount of electric wiring. This may involve longer horizontal air throws for which the blower type unit is most effective. If necessary, duct work may be installed on the outlets to deliver the heated air to any desired

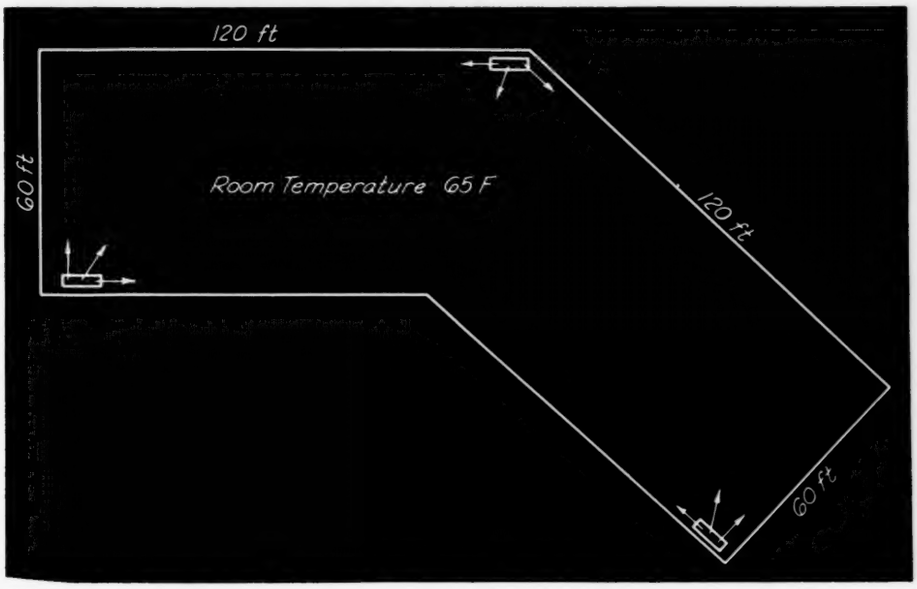


Fig. 5. Layout of second floor of manufacturing building for which floor type unit heaters were selected, placed as indicated. Data on this installation follow: 16-ft ceiling; heat loss, 819,000 Btu per hr; three floor type unit heaters, each 273,000 Btu per hr; maximum distance of throw, approximately 100 ft; mounting height 10 ft; outlet temperature 140F; required outlet velocity, 1600 fpm; total air circulation,

$$\frac{819{,}000}{[(140-65)\times 0.02\times 60]} = 9{,}100 \text{ cfm};$$

each outlet 9,100 cfm ÷ 9 = 1,000 cfm, approx.; area of outlet, 1,000 ÷ 1,600 = 0.63 sq ft.

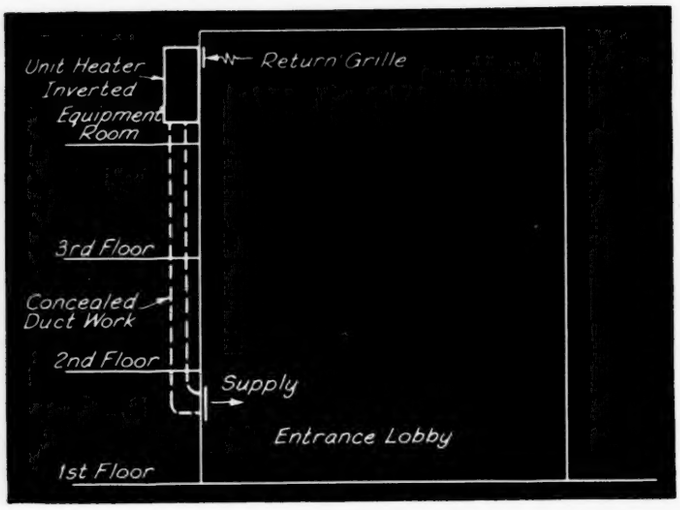


Fig. 6. How a unit heater was installed in a high entrance lobby.

locality. However, this type of unit is commonly installed without duct work and with one or more outlets arranged to discharge the warm air in suitable directions to provide the best distribution. The distance of throw will vary in accordance with the outlet velocity, the outlet air temperature, and the mounting height. With outlet velocity of 550 fpm, outlet temperature of 140F, and a mounting height of 10 ft, a throw of 40 ft should be obtained; with an outlet velocity of 2,300 fpm, 110F outlet temperature and 25 ft mounting height, a throw of 120 ft should be possible.

If floor space is available, the floor type unit is recommended because this permits picking up return air from the coldest zone near the floor. Floor type units were chosen, for example, for the installation shown in Fig. 5.

Where there is no room for a floor type unit, the horizontal suspended type may be used, and cowl type outlets arranged to direct the air stream toward the floor. Where there are sections of the building which have very high ceilings, as in the case of a dome over an entrance lobby, a blower type unit may be mounted against a wall or concealed in an inverted position to draw air from a point near the roof and to discharge the air, after reheating, through ducts to supply outlets at a normal level. This arrangement is shown in Fig. 6.

Projection type unit heaters are specially adapted to factory buildings with high roofs and where craneways must be kept clear or for installation near large doors which must be kept open for extended periods of time during cold weather. Where installed at moderate heights, they can be arranged to provide a wide air spread over the floor area by installing cone-shaped deflectors below, or when mounted under a high ceiling, to discharge a more concentrated jet of air at higher velocity to overcome stratification. By means of directional grilles, or adjustable louvers, the air stream can also be made to flow in any given direction. It is not necessary to locate units to prevent overlapping of the air streams as the projected heat goes to the floor and is diffused in all directions. Furniture and equipment do not have to be considered when locating these units as the air passes under and around such items. Fig. 7 shows a typical projection heater installation.

Without diffusers and with a mounting height of 12 ft, a small projection type unit will have a floor coverage 25 ft in diameter while a larger unit, also without diffusers but mounted 40 ft high, will have a floor coverage 90 ft in diameter.

The standard propeller type unit heater is adapted for installation in buildings where relatively short air throw is required and where quietness of operation

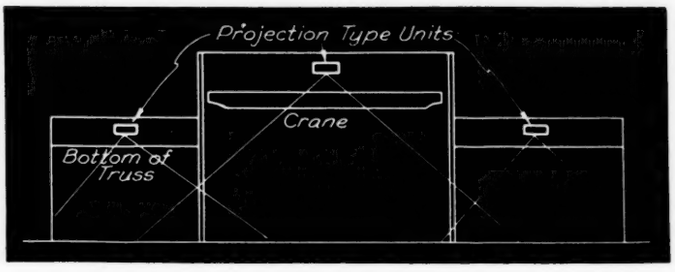


Fig. 7. Projection type unit heaters in factory building.

and economy of power are of more importance than low first cost. It is also more suitable for installations in which appearance is important. The distance of throw varies with face velocity and mounting height. The normal range is from 15 to 60 ft.

This type unit heater may be located to provide a blanket of warm air along the surfaces of exposed walls or placed in the center of the room to blow in the direction of exposed walls. If the latter arrangement is adapted, the units should be so directed that

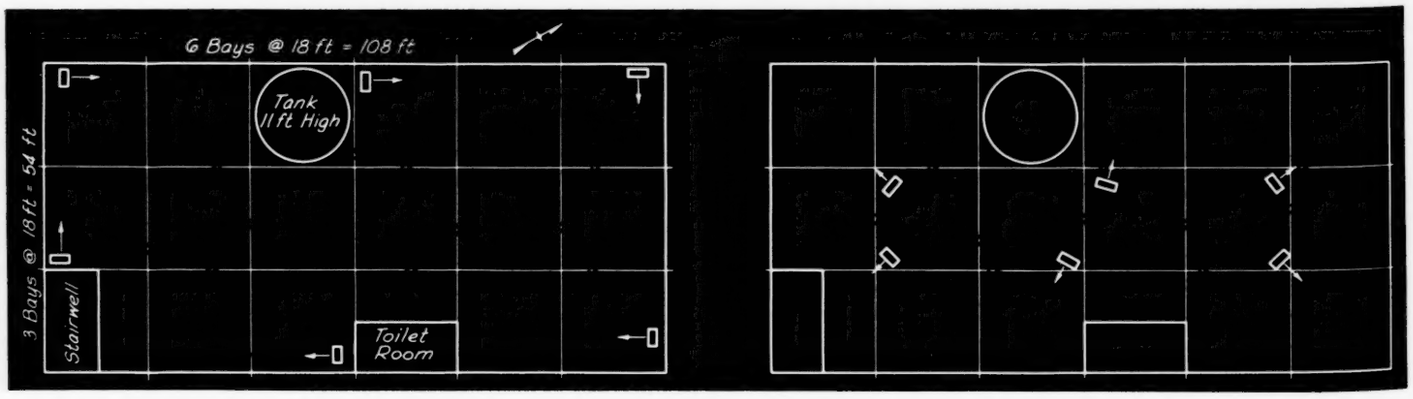
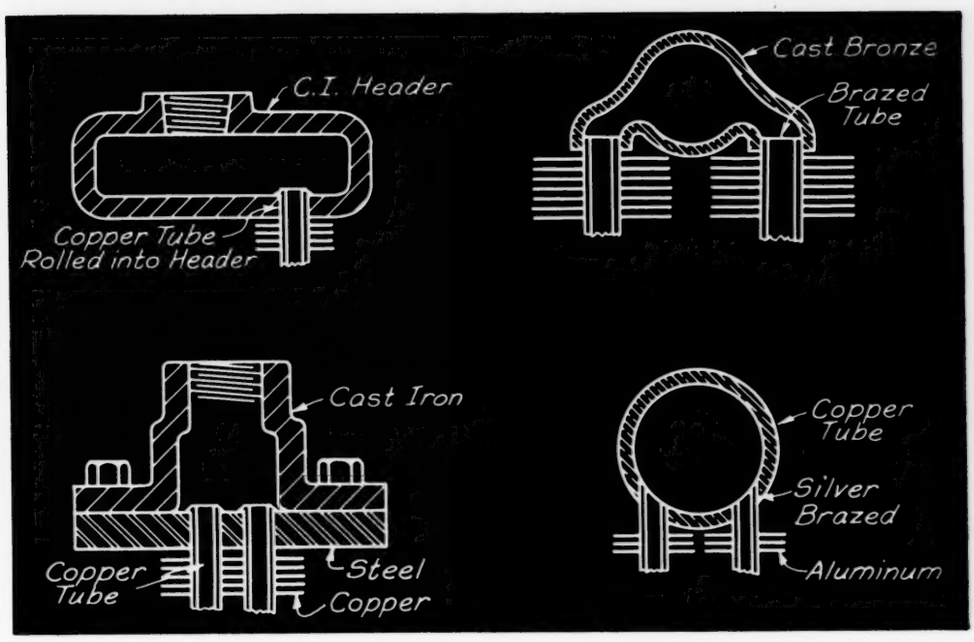


Fig. 8. Alternate arrangements of unit heaters, one, left, with heated air wiping walls, other with air blowing toward exposed walls.



Some examples of different types of headers: Fig. 9. (upper left) One piece cast iron header; Fig. 10. (lower left) cast iron with steel plates; Fig. 11. (upper right) cast bronze; Fig. 12 (lower right) copper type header.

the current of warm air will strike the wall or glass surface at an angle, thus providing a wiping effect with better distribution along the exposed surfaces. While it is desirable to space units as evenly as possible, it is generally necessary to forego ideal distribution to suit arrangement of partitions and equipment; it is, therefore, advisable to be conservative in sizing units and in the figures used for air throw. Mounting height should be such that the air stream will be above the heads of the occupants and, if possible, above nearby equipment which might interfere with the proper distribution of the heated air. Where beam and slab construction is provided for floors, it is important that unit heaters should be set low enough to prevent impingement of the air stream on beams projecting below the ceiling. Fig. 8 shows alternate arrangements of propeller type unit heaters for the same building.

Spacing of unit heaters is largely determined by the distance of throw. Figures given for the three types of unit heaters will serve to show the relative spacing possible with each type, but the manufacturers should be consulted for more accurate information when designing a heating system.

When the type, spacing and number of the unit heaters have been determined, the size of units required may be readily determined by dividing the total heating load by the number of units and selecting the nearest stock size units available.

Unit heaters are tested and rated in accordance with the standard Unit Heater Test Code of the Industrial Unit Heater Association and the ASHVE Ratings should be fully guaranteed.

After the major characteristics of each of the three types of unit heaters have been considered and the type of units to be used for a heating system has been determined, specifications, giving the basic requirements and listing information to be furnished by the bidders, should be prepared and sent to selected manufacturers. It is advisable to require each bidder to submit illustrations and literature showing and completely describing the units to be furnished in order that construction details may be properly compared.

Examples of such specifications for propeller or projection unit heaters and for blower type unit heaters are given in Tables 1 and 2.

Table 1—Example of Specifications for Propeller or Projection Type Unit Heaters

	Type 1	Type 2	Type 3
Number required and type	4 Prop.*	3 Proj.*	3 Proj.*
Minimum capacity at high speed, Btu per hr	25,000	40,000	60,000
Room temperature, F	60	65	70
Steam pressure, lb	5	5	5
Maximum outlet temperature, F	140	140	140
Mounting height, ft	10	10	12
Type of motor	Open frame ball bearing	Closed frame ball bearing	
Number of speeds	2	2	2
Power characteristics	110 volt, 60 cycle, single phase		
Heating surface	Finned copper		

Information below to be furnished by bidder

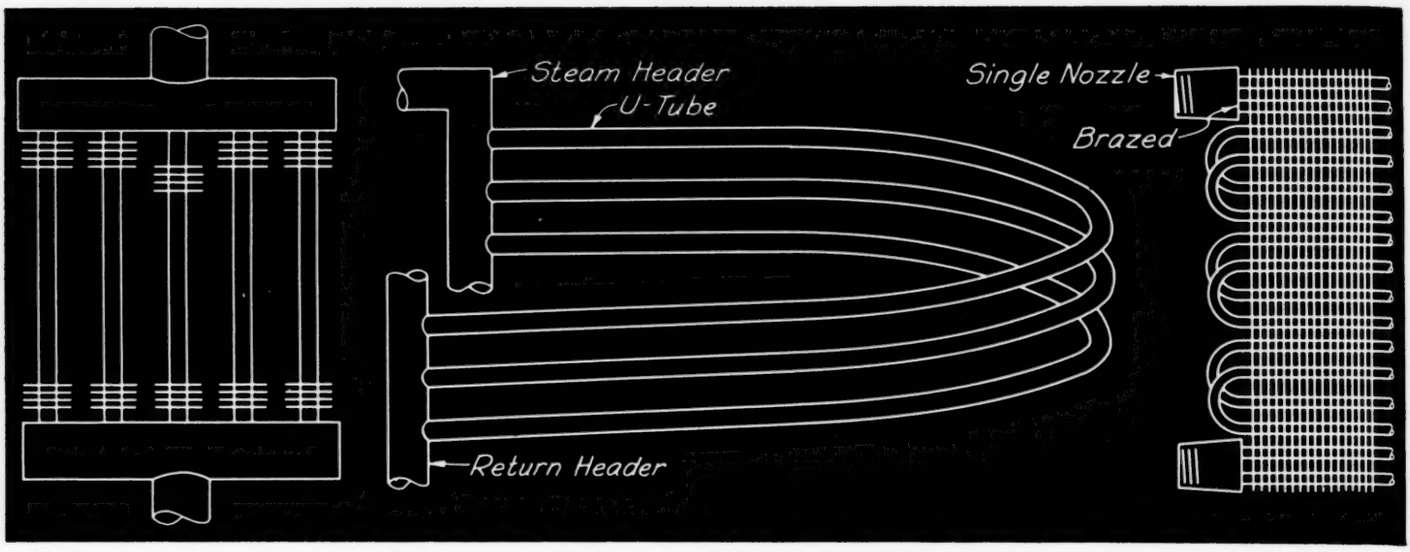
Model and size	Outlet velocity at 70F
Speed range	Maximum air throw recommended
Capacity at high speed and steam pressure specified	Motor horsepower
Outlet air temperature	Shipping weight
Cfm discharge at 70F	Sound rating (decibels)

*"Prop." indicates propeller type and "Proj." indicates projection type.

PROPELLER TYPE UNIT HEATERS

After bids have been received and the information requested from the bidders has been tabulated, details of construction of each unit should be considered, as well as the first cost of the units, before a selection is made.

For the propeller type unit heaters there are four major items to consider:



Arrangements of several types of supply and return headers: Fig. 13. (left) top supply and bottom return headers, both horizontal; Fig. 14. (center) schematic drawing of vertical headers at same side with connecting U-tube surface; Fig. 15. (right) each header replaced by a single large nozzle.

Table 2—Example of Specifications for Blower Type Unit Heaters

	Type 1	Type 2	Type 3
Number required	4	3	5
Maximum capacity, Btu per hr	400,000	260,000	1,000,000
Room temperature, F	65	65	65
Steam pressure, lb	5	5	5
Required air capacity at 70F cfm	4,500	3,000	12,000
Maximum desired outlet temperature, F	140	140	140
External resistance, in.	None	None	¾ SP
Installation position	Floor	Wall inverted	Horizontal
Heating surface	Finned copper		
Type of motor	Totally enclosed		
Number of speeds	2	2	2
Power characteristics	440/3/60	110/1/60	440/3/60
Number of outlets	3	2	3

Information below to be furnished by bidder

Model and size	Outlet velocity at 70F
Fan speed range	Maximum air throw recommended
Capacity at high speed and steam pressure specified	Motor horsepower
Outlet air temperature	Shipping weight
Cfm discharge at 70F	Sound rating (decibels)

(1) Heating surface which includes headers, prime surface and secondary surface;

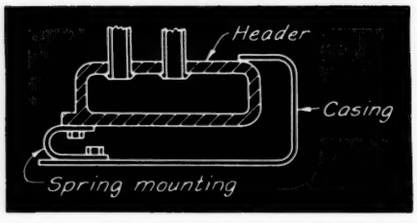


Fig. 16. Floating return header.

(2) Casing which includes louvers and fan mounting;
(3) Fan; and
(4) Motor

Types of construction found in several well known makes of unit heaters are outlined to illustrate the wide variation of construction details that may be encountered.

Heating Surface

Headers in representative makes of unit heaters examined are variously constructed of one piece cast iron, Fig. 9; cast iron headers with cold rolled steel header plates, Fig. 10; cast bronze, Fig. 11; or round seamless copper tubes, Fig. 12.

A common arrangement, Fig. 13, is with a top horizontal supply and a bottom horizontal return header, with the inlet and outlet connections in the center of the headers. This makes a very satisfactory arrangement for piping the units.

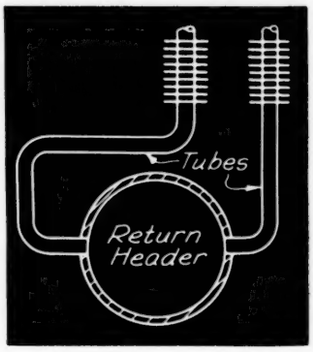


Fig. 17. One arrangement of tubes to take up expansion.

A second arrangement, Fig. 14, favored by some manufacturers, has two vertical headers at the same side with supply connection in the one and return connection in the other. With this plan the supply header is usually set somewhat higher than the return header and the tapping for the return connection must be at the bottom of the return header.

In a third arrangement, Fig. 15, supply and return headers are replaced by a single large nozzle piece for the supply and a similar nozzle with smaller outlet for the return connection, with two or more continuous coils between the connections.

The prime surface of most propeller type unit heaters varies from one to three rows of tubes. One-row units are satisfactory where a small amount of

heat is to be delivered over a large area, especially for a long narrow room where it is necessary to have a long air throw. One-row units should not be used on hot water systems as the outlet temperature will be too low.

Two-row units are most commonly used and are usually the most economical under average conditions. Three-row units may be used where high outlet temperatures are permissible or desired. This reduces the quantity of air to be moved for the same amount of heat with a resultant saving in power.

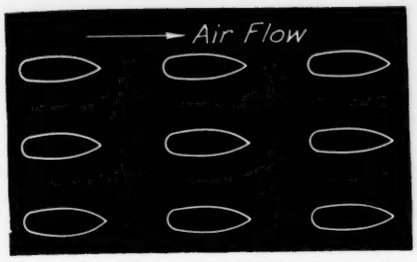


Fig. 18. Airfoil type tubes to decrease air resistance.

Where headers and tubes are constructed of nonferrous material, the tubes are usually secured to the headers by silver brazed joints. If the headers are of cast iron or steel, the tubes are ordinarily reinforced with ferrules and expanded or rolled into the header.

Tubes as commonly furnished are from ½ in. to ⅝ in. OD and with wall thickness of about .025 in. In some makes, using straight tubes, a floating return header is furnished, Fig. 16. Another method of allowing for expansion is to use restricted orifices at the entrances to the tubes to insure simultaneous delivery of steam to all of the tubes, so that there is equal expansion of the tubes when steam is admitted to the unit.

An alternative method is to have a 90 deg expansion bend in each tube before it enters the return header, as shown in Fig. 17, to overcome strains due to expansion and contraction when unit heaters are exposed to fluctuating pressures and temperatures. This feature is specially desirable where automatic control of the steam supply is provided.

In most makes the tubes themselves are circular in cross section but in some cases special shapes are provided to reduce the friction of the air stream through the unit (see Fig. 18).

Staggered spacing of tubing is standard practice with some manufacturers (Fig. 19, left); others who streamline their tubes to reduce air friction favor the straight line arrangement of tubes.

Units not equipped with headers have one, two, or three continuous trombone type copper coils and fins. The coils are staggered, and are arranged to provide for rapid drainage of the condensate and for freedom from expansion strains on the coil or external piping. The copper tubes are silver brazed to the bronze supply and return nozzles, as illustrated in Fig. 15.

Secondary surface is usually provided in the form of fins. Primary and secondary surface should be proportioned to provide the maximum heat transfer from the heating medium to the air, and at the same time keep down the resistance to air flow across the heating surface.

One manufacturer provides primary surface and secondary surface in the ratio of 1 to 8 for steam type unit heaters and in the proportion of 1 to 3 for hot water type unit heaters. The reason for the higher proportion of secondary to primary surface with steam is because of the higher heat transfer characteristics with steam as compared with hot water, due to the latent heat given up by the steam when condensing.

Fins may be made in plates, the full inside width and depth of the unit, with openings of the proper number and size to suit the tubes, or they may be individual plates on each tube (see Fig. 19). In either case, it is essential that close contact be provided between the fins and the tubes all around to insure maximum heat transfer. Use of the same metal for fins and tubes eliminates electrolitic action and resultant corrosion at the junction points where two dissimilar metals exist in the presence of drops of moisture containing traces of acid which may condense on the fins while the unit is idle during the nonheating season.

Some manufacturers insist on metallic bonding of fins and tubes (for example, Fig. 20), while others provide a tight fit by pressing the fins on the tubes, or by expanding the tubes in the fins.

Whichever type of construction of header, tubes and fins is used, it is essential that the units be designed and tested for the maximum pressures and temperatures that are likely to occur. Most unit heaters of this type are guaranteed to withstand steam pressures and temperatures up to 150 lb saturated.

Casing

Casings are an important feature of unit heaters, not only from the standpoint of appearance, but because they serve to collect the air as it leaves the fan and distribute it evenly over the face of the heating surface. They also serve to support and maintain the heating surface, the motor, and fan in their proper relationships with each other.

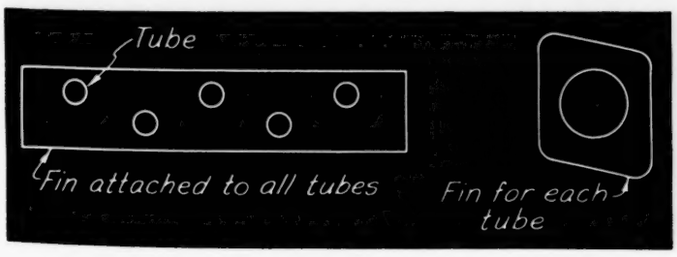


Fig. 19. Left, finned surface attached to multiple tubes; right, individual extended surface for each tube.

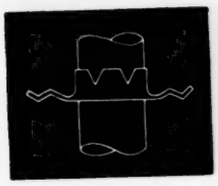


Fig. 20. One method of attaching fins to tubes.

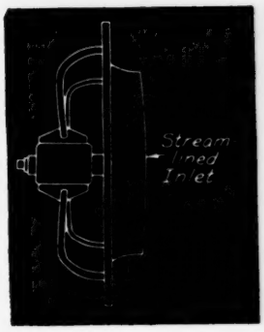


Fig. 21. Streamlined inlet to fan casing. Here the motor is supported by radial brackets.

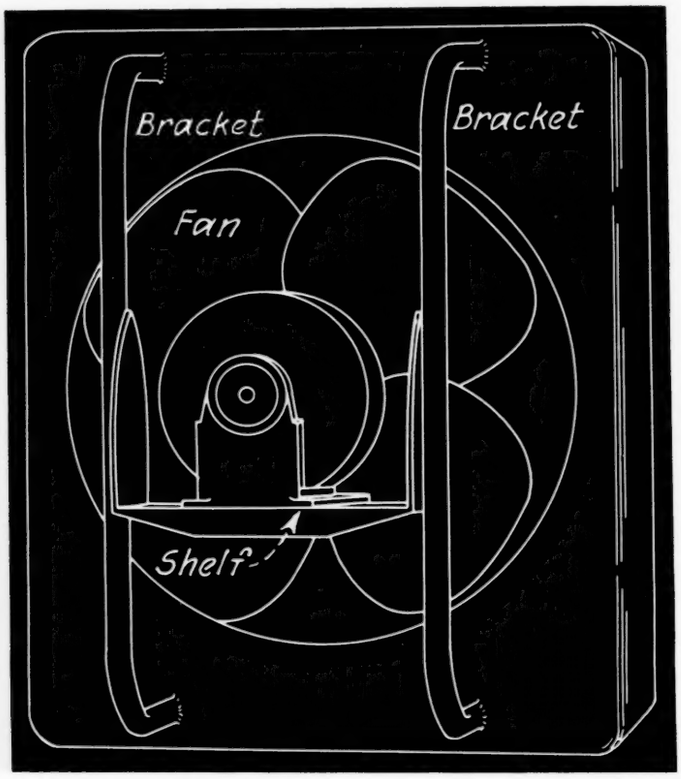


Fig. 22. In this case, vertical brackets support the motor.

It is essential that casings be of rigid construction to maintain the proper alignment of parts and to eliminate squeaks, vibration and rattling. Welded joints are desirable to insure rigidity except for such joints as are required for access to or removal of parts from the unit. When bolts are necessary, they should be of noncorrosive material and should be arranged to avoid projecting nuts or bolt heads.

Some makes of unit heaters have a casing of sufficient depth to conceal the heating surface, the fan and nearly all of the motor, while others house the heating surface, and leave the fan and motor exposed.

The back plate of the casing is shaped in some units to provide streamlined inlets, reducing the power requirement, as in Fig. 21. Another method is to provide curved vanes, spaced radially from the center of the fan between the fan and the heating surface to provide even distribution of the air over the full face area of the unit.

Supports for mounting the motor and fan in some types consist of two, three or four arms extending radially from the motor frame to the back of the casing (see Fig. 21); in other cases, two vertical brackets from top to bottom of the casing, with a shelf mounted between them, are provided for the motor, Fig. 22. While it is desirable that the motor supports be designed to provide minimum interference with the air flow, it is equally important that they be rugged enough to withstand the strain of frequent starting and stopping of the fan.

Adjustable louvers for directing the air stream should be provided on the face of the unit, as shown on the front view of Fig. 1. These should be preferably individually adjustable and capable of being locked in place after adjustment. They should be of substantial construction and should not flutter in any position when the fan is in operation. Some manufacturers furnish louvers which are balanced on center pins to guard against changing position due to their own weight.

Where appearance is important, casings may be constructed of furniture steel, die formed with rounded corners and edges. Satin finish aluminum trim may be provided to cover the necessary joints, and the body finished in black or colors.

Where appearance is not a major consideration, stress should be placed on smooth surfaces and a finish that can easily be kept clean.

Fan

The fan should be of suitable design to provide the necessary flow of air in an even stream, without pulsation or other noise, and with the minimum consumption of power. It must be of rugged construction to withstand stresses due to high speed of rotation and must be securely fastened to the shaft to prevent turning or sliding along the shaft.

Blades may be constructed of aluminum or of steel plate and should be dynamically balanced to provide smooth operation at high speeds. The number and shape of the blades vary from two epicycloidal blades to four narrow blades with almost constant pitch along the edge of the blades. With a blade of constant pitch, there is a tendency to discharge the air in the form of a ring. One manufacturer, therefore, provides fixed radial blades between the fan and heating element to distribute the air more evenly over the surface of the unit.

With fans of small diameter, higher speed motors may be used without excessive centrifugal stresses, thus reducing the motor size and the unit cost. Fan

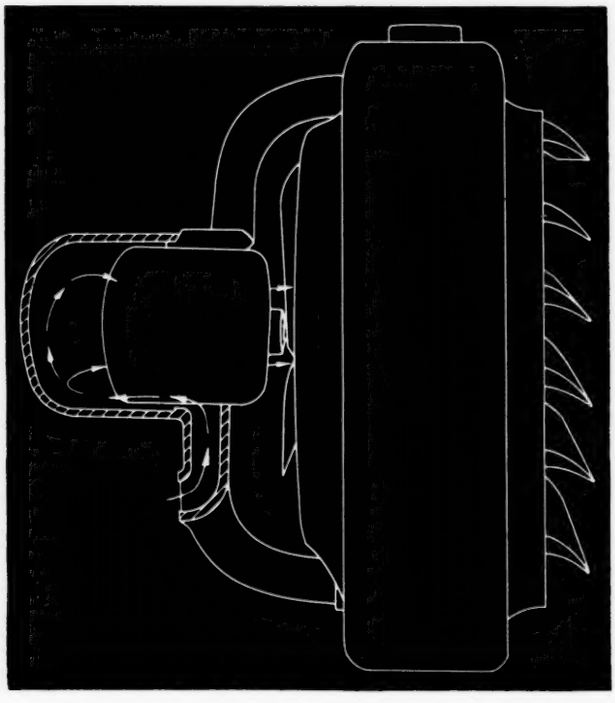


Fig. 23. Air is drawn by fan into housing and around motor for cooling motor.

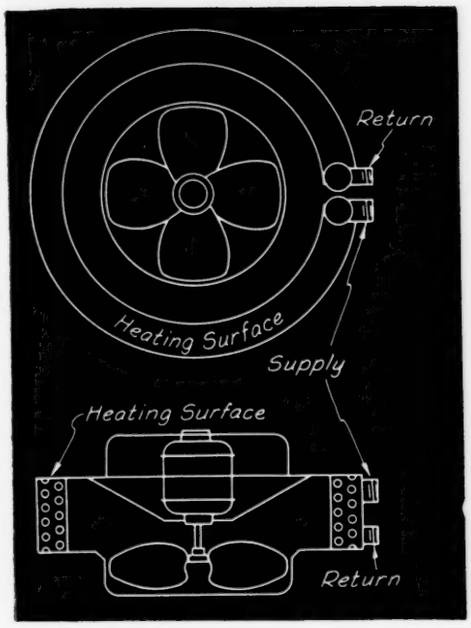


Fig. 24. Header arrangement for one type projection unit heater.

wheels vary from about 7½ to about 24 in. diameter.

Motor

Motors for propeller type unit heaters are commonly of the totally enclosed type and should be of proper size to permit the unit to operate at its specified capacity without having the temperature rise of the motors exceed 55C (131F) above an ambient temperature of 40C (104F). If open frame motors are furnished, the temperature rise should not exceed 40C above an ambient temperature of 40C.

One unit heater has a tubular lower support for the motor with an opening near the bottom through which air is drawn up into the housing around the motor, through the rotor of the motor, and out through openings in the front of the housing. This provides a current of cool air for removing heat generated by the motor, Fig. 23.

Motor construction should conform to the latest standards of the American Standards Association. Motors must be furnished to suit the voltage and type of current available, and should be suitable for full voltage starting without reduced voltage equipment. They should be designed and constructed to withstand the maximum service conditions, and the characteristics should be such as to give minimum starting current for positive operation of the fan. Motors may be of single, two or three-speed type as desired, and equipped with seal type grease lubricated ball bearings or wool packed sleeve type bearings. Conduit terminal boxes should be provided for the leads.

PROJECTION TYPE UNITS

Projection type heaters also consist of the same four major items listed for propeller type unit heaters but there are some differences in construction which should be considered.

The unit is generally of the draw-through type and is so arranged that in plan view the heating surface forms the perimeter of a circle or four sides of a square. The air is drawn inward through the coil surface and is heated before it reaches the fan.

Heating Surface

The heating surface will have the same component parts as the propeller type unit but because of the arrangement of piping, very compact headers are feasible. With the circular shaped unit two vertical headers, one for supply and the other for return, may be installed side by side. The supply header will have an inlet connection near the top and the return header will have an outlet at the bottom as in Fig. 24.

Units with heating surface in the form of a square, Fig. 25, have a supply header at one corner and a return header at the other corner.

Coils may be one or two rows deep in the direction of air flow and from two to four rows high. Tubes are secured to the headers, and fins to the tubes, in the same manner as for propeller type units.

Headers, tubes and fins may be of nonferrous materials, or cast iron headers with steel tube and fins may be furnished.

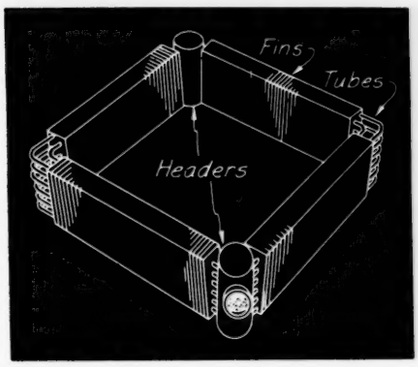


Fig. 25. Supply header on square projection unit is at one corner, return header at diagonally opposite corner.

Casing

Casings include top and bottom plates, vertical side pieces or wire grilles, motor supporting brackets, outlet rings, diffusers and louvers or nozzles. The top casing may be provided with a cone shaped depression which

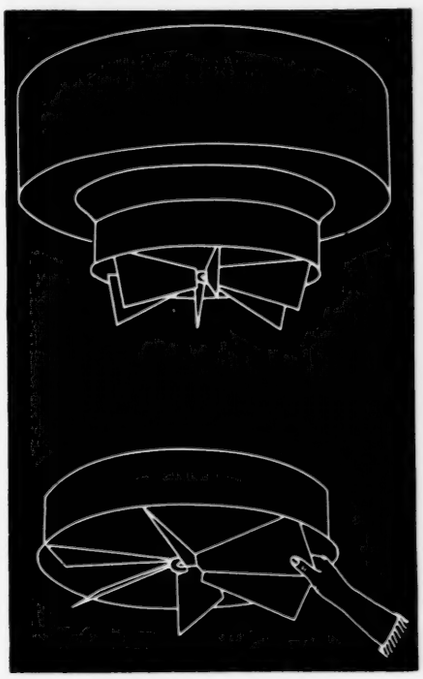


Fig. 26. Adjustable blades on projection heater outlet. In the upper view, blades are nearly vertical; in lower view they are being changed to a nearly flat position.

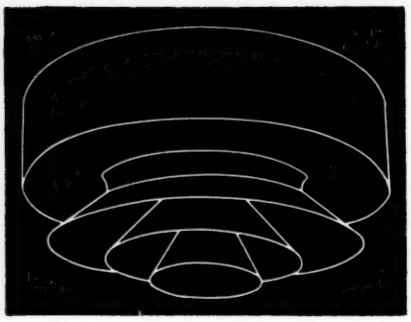


Fig. 27. Anemostat type outlet for projection heater.

not only serves as a guide for the air entering the fan, but also provides space for the motor, or it may consist of a flat plate reinforced with stiffening angles with a small cylindrical pocket for the motor. The bottom plate may be equipped with a radial or spoke type deflector having individually adjustable blades, Fig 26; with anemostat type outlets to diffuse the air without drafts, Fig. 27; or with louvers to direct the air stream toward one general area. One type is equipped with a cone jet deflector, Fig. 28, mounted on a plate which is separated by a vertical gap from the unit proper. This is to induce air flow through this gap, thus handling more air and reducing the outlet temperature.

Some makes of circular shaped units have the top and bottom plates connected together by a grille. This improves the general appearance without restricting air flow.

Still another type has discharge outlets which slowly revolve so as better to circulate the heated air. This type is illustrated in Fig. 29.

Square shaped units may have vertical corner plates to connect the top and bottom plates and at the same time to conceal the short sections of bent tubes where fins cannot be installed. Fig. 30 shows the finished appearance of the surface illustrated in Fig. 25.

Fan

Fan blades are generally of similar construction to those provided for propeller type unit heaters of similar capacities.

Motor

Motors are also of similar construction to those provided for propeller type units with the exception that they must be suitable for installation and operation in a vertical position. This requires that bearings and lubrication be designed accordingly. As this type of unit is commonly installed in locations where it is not readily accessible for lubrication, it is desirable that sufficient lubricant may be provided to last during the entire heating season.

BLOWER TYPE HEATERS

The heating surface of blower type unit heaters is commonly installed on the inlet side of the fan and consists of short headers at opposite ends of the unit with finned type tubing between the headers, Fig. 31. As the heating surface is comparatively long, it is necessary to provide for expansion of the tubing when heated. This may be done by offsetting the tubes to provide the necessary flexibility. With headers at opposite ends, the supply and return connections will also be on the opposite ends of the unit. If units are installed in locations where both ends are accessible, this arrangement is satisfactory, but some manufacturers provide heating surface with steam and return headers, and connections on the same end with U-shaped tubes connecting the two headers. This is desirable where the unit must be installed in a corner.

Materials of headers, tubes and fins, and the connections between them, are similar to those used for propeller type units.

Casing

Casings are furnished in several forms including high and low model floor units, wall type units, and ceiling type units, Fig. 3. Casings include the body proper which encloses the heating surface, fans, and the filters if required, the motor support, the guard over the belt drive, the outlet cowls or grilles, and the feet in the case of vertical units.

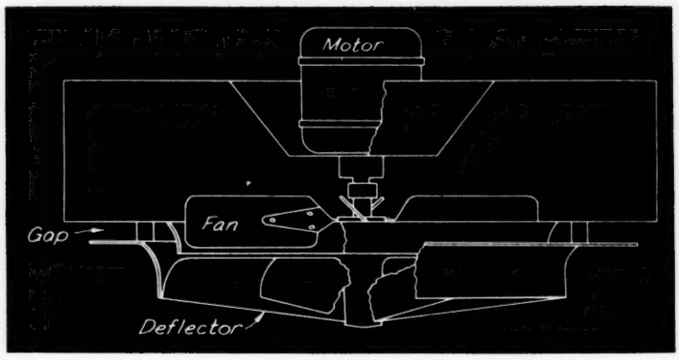


Fig. 28. Louvers to direct air stream are employed in this heater.

Casings should be ruggedly constructed of not less than 14 gage steel plate reinforced with angles or channels of not less than 10 gage steel. The joints should be welded except when removable plates are required for access to fans and heating surface. Bolted plates should be provided with bolts and nuts of nonferrous materials to permit their ready removal after a long period, if necessary to open the unit for inspection or repairs.

Motors are usually mounted on the outside where they are out of the heated air stream and accessible

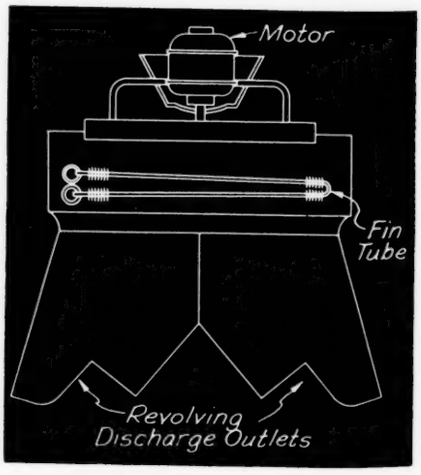


Fig. 29. In this unit the discharge outlets slowly revolve to obtain better air distribution.

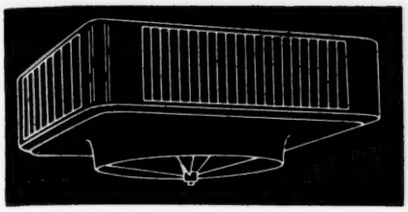


Fig. 30. Casing covers headers and corners of unit shown in Fig. 25.

for lubrication and inspection. A substantial bracket should be welded to the casing to support the motor without vibration when operating at the maximum speed.

Floor type units are usually provided with legs die formed from heavy steel plate preferably of not less than 10 gage steel.

Separate outlets are commonly provided for each fan. These outlets may be either of short or long neck design in accordance with the requirements for air throw. Cowl type outlets at the end of the neck pieces may be arranged to discharge the heated air in any desired direction, or duct work may be attached to the fan outlets to deliver the heated air to any desired location.

As the distance of throw is dependent on the air velocity leaving the unit, the area of the cowl outlets is important and should be checked before ordering.

Wall type units may be of the vertical or inverted type, and do not require legs. Otherwise, their construction is similar to the floor type units.

Ceiling type units are also furnished without legs and as they are installed in a horizontal position the cowl outlets are usually designed for a slightly angular downward discharge.

When duct work is to be provided from any or all of the outlets for floor, wall or ceiling units, the regular necks and cowl outlets should be omitted, and the duct work should start from the casing of the unit heater.

Fans

Fans for blower type unit heaters are usually double width, double inlet, housed, centrifugal fans with multiblade forward curved type wheels mounted on a common shaft for parallel operation, as indicated in Fig. 31.

The forward curved blade type of fan has the advantages of maximum capacity for size of fan, and quiet operation. As in most installations, the unit is installed without duct work, there is no uncertainty as to the static pressure against which the unit must operate, and therefore no danger of overloading the motor. If duct work is to be installed on the outlets, the resistance of the system should be carefully computed and the manufacturer advised when quoting on the unit.

The fan shaft is generally long and, in some cases, a center bearing may be provided in addition to bearings at each end. If such a bearing is required, provision must be made either in the design of the unit or in the method of the installation to permit access to this bearing for inspection and lubrication. If bearings are provided on the ends only, the shaft must be of ample diameter to withstand stresses due to deflection and high rotative speed. Bearings may be either ball bearing or of the sleeve type.

Motors

The motor may be of standard construction of suitable type for the operation of the unit at either constant or variable speed as desired, and wound to suit the type and voltage of current available. It may be either direct connected to the end of the fan shaft by means of a flexible coupling, or through V-belt drive and pulleys. If a V-belt drive is furnished, sliding rails should be provided under the fan to permit adjustment of the belt, and a belt guard added to prevent accidents.

It is essential that if a unit heater is to be installed in a horizontal or inverted position, the manufacturer be advised in order that suitable bearings may be provided for the fan shaft and for the motor.

Filters

Filters are sometimes used with unit heaters of this type and these are usually of the throw away style consisting of a frame with an inexpensive refill filter pad which may be replaced by a new pad when dirty. The unit heater should be so arranged that filters, if provided, are readily accessible for replacement.

SUPPLY AND RETURN CONNECTIONS

Typical supply and return connections for use with low and high pressure steam are shown in Fig. 32, 33 and 34. The essential requirements of a good piping job for a unit heater are:

1. Proper size and arrangement of supply and return connections to deliver the full amount of steam or hot water required under maximum conditions of load on the unit heater, and to permit the rapid removal of condensate or water from which the heat has been extracted;
2. Removal of air or other noncondensable gases as rapidly as they maye be liberated or formed; and
3. Provision for cutting out the unit for inspection or service without interference with the operation of the remainder of the system.

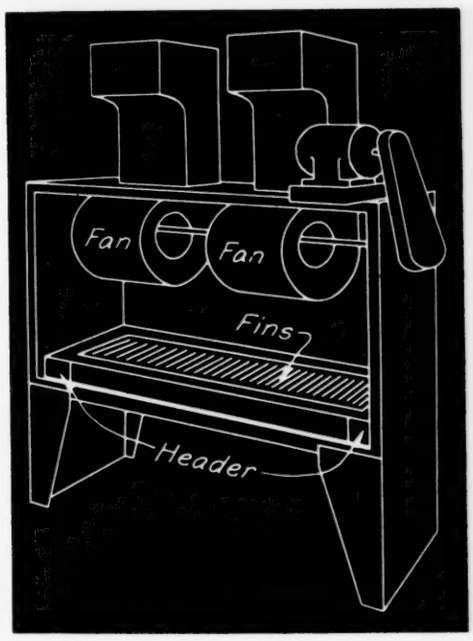


Fig. 31. General arrangement of floor type heater showing headers, heating surface and dual fans. In some cases three or even four fans are used.

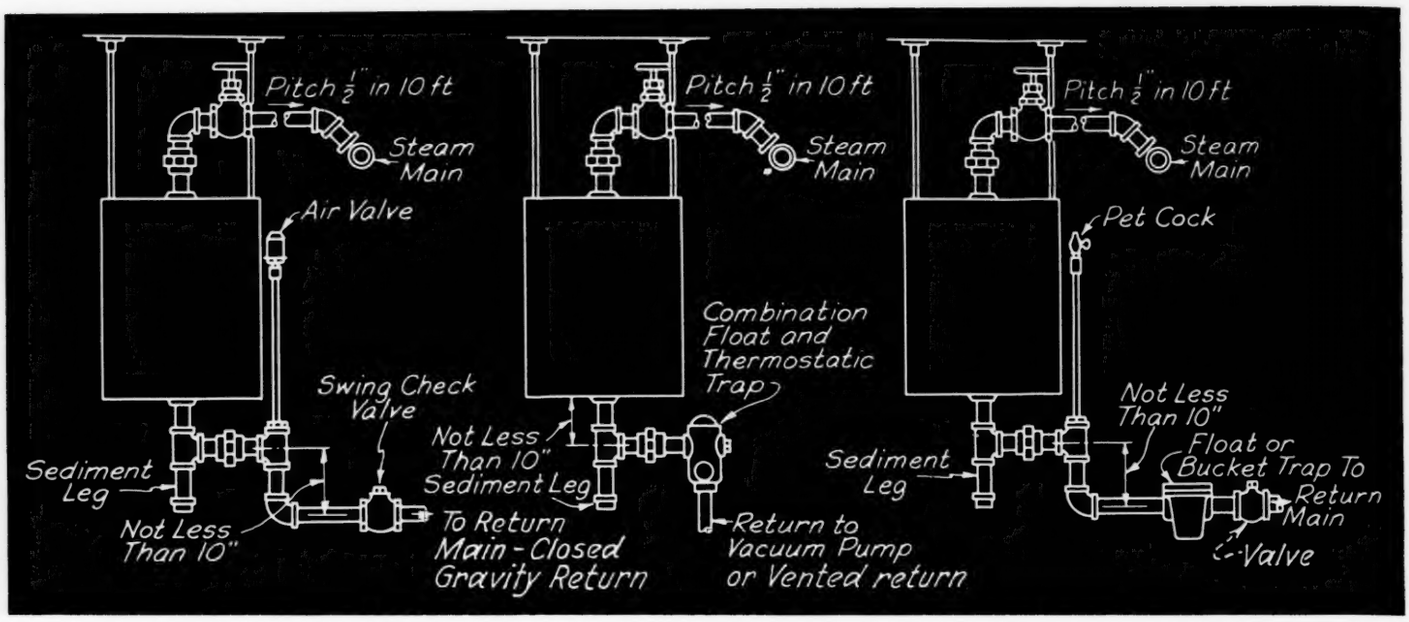


Fig. 32. (Left) Piping for low pressure gravity steam system, with a closed gravity return. Fig. 33. (Center) Piping for vacuum pump system or system with vented return. Fig. 34. (Right) Piping for high pressure gravity steam systems.

With on-and-off control of the unit, a gate valve may be provided in the supply to the unit. This valve is normally left wide open but may be closed if necessary to remove the unit heater for repairs or adjustment.

If modulation control is to be provided, then the valve in the supply line must be opened or closed by steps in accordance with the heating requirements. Where such a valve is used, it is advisable to provide a gate valve in front of it, which may be closed when necessary to remove or repair the automatic valve. Return connections should always be the full size of the tapping on the unit heater and should be provided with a dirt pocket with removable cap to catch any dirt or scale that may pass through the heater.

With a vacuum system or a low pressure steam (below 15 lb pressure) and a vented return system, a combined float and thermostatic trap provides a satisfactory means of passing both condensate and air without allowing the passage of steam. With a closed gravity return system, the air should not be discharged into the return main and it is advisable to install a quick vent air valve from a connection between the heating surface and the check valve.

If modulation control is provided on the supply to the unit heater and fans run continuously, it is advisable to provide a vacuum breaker on the connection to the quick vent air valve, to prevent formation of a vacuum in the heater when the steam supply is throttled.

With high pressure steam, a bucket type trap is desirable for the returns, and a pet cock should be provided to permit removal of the air when starting up the unit.

With low pressure systems, it is desirable but not essential to provide a gate valve beyond the trap, but with a high pressure system, a valve should always be provided to permit opening or removal of the trap, if necessary.

With hot water connections, a gate valve should be provided on both supply and return connections and a pet cock should be installed for venting the system when filling, or when air collects in the unit during operation.

THERMOSTATIC CONTROLS

A commonly used and generally satisfactory method of controlling the output of a unit heater to suit the demand is by a thermostat so connected that, when a predetermined temperature is reached, the current to the motor will be shut off and the unit stopped. The valve in the steam supply to the unit is not automatically controlled. This method reduces the stresses on the heating surfaces of the unit because the pressure and temperature in the heating element remain constant. The thermostat should be so located that it will not be in the path of the warm air stream from the unit heater.

Thermostats for small unit heaters should be designed for the maximum current and the voltage required by the motor. Thermostats without thermometers, but with lock covers and key adjustment to prevent change of setting by unauthorized persons, are desirable. Thermostats should be provided with a conduit mounting box.

In some cases it is advisable to provide low limit control in addition to the room thermostat. This consists of a surface aquastat strapped on the return line between the unit heater and the trap. If there is no steam at the unit this will prevent operation of the fan and thus prevent objectionable blasts of cool air.

Modulation control of unit heaters is sometimes provided. The advantages claimed for this type of control are constant discharge temperatures in place of intermittent blasts of hot air and a tendency to decrease stratification.

If a modulating valve is used, it is advisable also to provide auxiliary pressure control to shut down the fan when the pressure is reduced to a point where the heating capacity of the steam becomes ineffective.

Ventilation Requirements for Industrial Solvents—Part 4:

Industrial Applications of the Dilution Principle

W. C. L. HEMEON

Industrial Hygiene Foundation,
Mellon Institute, Pittsburgh, Pa.

The fundamental principles described in the preceding articles of this series apply to all processes where a solvent may evaporate into the working atmosphere. A discussion of selected design problems encountered by the writer is presented in this concluding section as illustrative of the practical application of the principles of solvent vapor dilution.

A COMMON ventilating arrangement for rubber fabricating operations is the work table with exhaust slots at both long edges, similar in principle to the conventional arrangement for plating tanks. This method of exhaust has seen wide application during accelerated war production of miscellaneous sheet rubber cementing operations: raincoat making, barrage balloon, and self-sealing gasoline tanks accessories, life rafts, life preservers, and many others.

An empirical design basis has been widely adopted for specifying the rate of air exhaust, namely, 50 cfm per sq ft of bench area. This basis has been fairly successful in maintaining satisfactory atmospheric conditions in such shops, often, however, by grossly over-ventilating the space at the expense of heat and heating equipment for winter operation.

Design Factors

The principles employed in the previous articles apply to the common double-slot exhaust, therefore no flat rule like 50 cfm per sq ft is universally appropriate.

If the job dilution rate for the operations at a particular bench is 1500 cfm and the bench area 30 sq ft, then an exhaust of 50 cfm per sq ft would result in vapor concentrations inside the duct system itself that would be acceptable for the general atmosphere. Now since the mechanical arrangement under consideration is partially a local exhaust system (because some of the vapors will be withdrawn at their source), the average concentration inside the duct system can and should be materially greater than the design concentration. The higher the concentration of vapor in the exhaust air, while maintaining satisfactory concentrations at breathing level, the more economical are the results.

Where the economics warrant, detailed calculations should be made, considering (1) the rate of evaporation of solvent and (2) location of evaporation sources relative to the exhaust slots. Application of (2) enables an estimate of the relative proportion of total vapor that will originate entirely within the field of local exhaust. The data of Table 5 (H&V:3:46:p84) will serve to define the local exhaust area.

Fig. 4. Underground oil storage tank whose lining with synthetic rubber sheeting is nearly complete. During application of the lining, the atmosphere was contaminated with vapors of the volatile solvent methyl-ethyl ketone. The successful application of dilution principles to this problem is described in the accompanying article. Photo courtesy Boston Woven Hose and Rubber Co.

Approximate Rule

For approximate estimates where possible economies are limited, one may assume, arbitrarily, that one-half of the vapors will be withdrawn by local exhaust and the other half will constitute spillage. Then the proper ventilation rate through the lateral exhaust would be 50% of the job dilution rate for the particular operation. Thus, if the rate of evaporation is such as to indicate a dilution rate of 1500 cfm, one would estimate a suitable (approximate) ventilation rate of

$$1500 \times 0.50 = 750 \text{ cfm.}$$

Canopy Hood

On one occasion, the writer designed ventilation for a series of machines, each of which evaporated solvent

from a small open tank tended by a worker. Equipment surrounding the edges of tanks would make it extremely inconvenient, if not impractical, to install lateral exhaust slots. It was equally impractical to bring any exhaust connection down closer to the tank surface than the level of the worker's head.

Unconventional

There was a simple though unconventional solution to the problem—installation of small canopy hoods above the tanks, just above the worker's head, with air exhausted at a rate adequate to dilute the vapors to the ventilation design concentration. Much to the consternation of others, this design was followed and the ventilating system installed.

The argument against the design was conventional —that the exhaust would draw the vapors upward past the face of the worker, thus subjecting him to excessive concentrations. It was also objected that the vapors were heavier than air and, therefore, would tend to overflow the sides of the container and sink to the floor.

Objection Answered

The answer to the first objection will be apparent to the reader from the following discussion. The air flow specified was such as to result in acceptable concentrations up inside the hood and the interior of the duct system itself. Therefore, while it could be stated that there was a tendency for vapors to be drawn upward from their source past the breathing level of the worker, it was equally true that fresh air was also being drawn past the breathing level and in just the right proportions to result in satisfactory concentrations at that point.

The inherent absurdity of the vapor density concept that constituted a part of the objection to this design has been demonstrated in our previous discussion of this subject.*

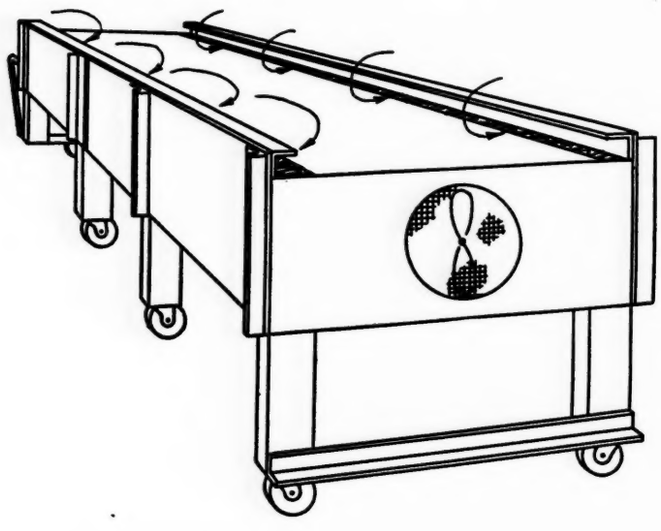


Fig. 5. Portable ventilated bench for application of rubber cement to sheet material. Slots for exhaust along both sides communicate with chamber underneath. Propeller fan discharges contaminated air directly into working space but highly diluted.

Underground Tanks

The unusual ventilation problem described below illustrates a striking application of these design principles. An underground concrete oil storage tank was to be lined with sheet material by an operation roughly similar to a wall-papering job, but employing a rubber cement adhesive containing the volatile solvent, methyl-ethyl ketone (See Fig. 4). The tank, nearly 150 ft in diameter and 20 ft high, had only two small openings in the ceiling. Work benches were to be placed on the floor inside and a crew of men engaged for one to three weeks, working 8 hours daily, to cement the sheet material to walls and floor. Cement would be applied to the sheeting as it lay on the benches and again to the section of wall or floor designed to receive the strip.

Local exhaust for removal of vapors at their source was plainly out of the question.

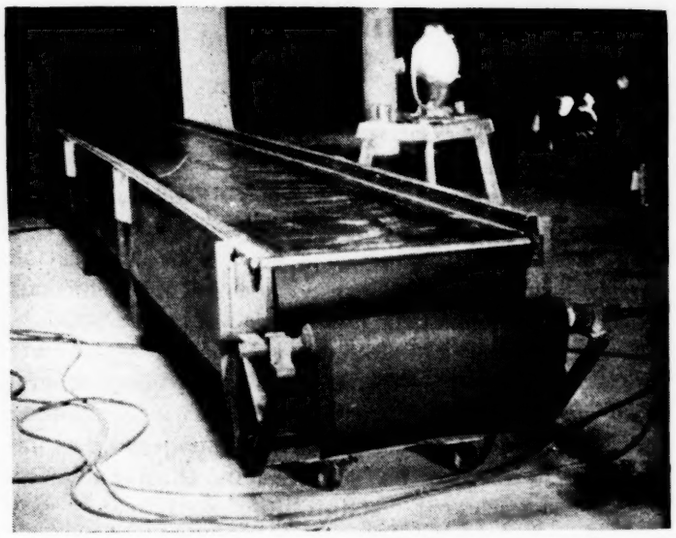


Fig. 6. Photograph of arrangement illustrated in Fig. 5 viewed from opposite end.

Application of principles of design outlined in these articles was successfully employed. The pertinent data are summarized below.

Design Data

Solvent: Methyl-ethyl ketone is not known to be toxic but possesses an odor likely to be highly objectionable to workmen in high concentrations.

Ventilation Design Concentration: To ascertain the maximum concentration of the vapor that might be tolerable and acceptable to workmen tests were conducted in a test chamber (at the Harvard School of Public Health under the direction of Professor Philip Drinker), where several subjects were exposed for 5 minutes to various concentrations and asked to vote on each. All agreed that 200 ppm would probably be considered satisfactory. On the basis of these tests a concentration of 150 ppm was selected as the ventilation design concentration.

Rate of Solvent Evaporation: From preliminary

* "Air Dilution in Industrial Ventilation," by W. C. L. Hemeon, HEATING AND VENTILATING, March, 1941. P.72).

tests conducted by the contractor on the probable rate of application it was estimated that solvent would be used at an average rate of 11 pints per hour, but the "spot rate" would be 10 times as great, or more, during a few minutes.

Sources of Evaporation: Surface of work benches 3 ft wide and 20 ft long, which would be mounted on casters and moved frequently to various parts of the space; also from spaces of double width and the same length on successive sections of the wall or floor, i.e., 6 ft wide and 20 ft long.

Method of Design

The job dilution rate for the space, on the basis of 11 pints per hour, is seen to be slightly less than 6000 cfm; hence an air supply of this magnitude would maintain *average* concentrations at about 150 ppm. In the final design the air supplied became 8000 cfm and fresh air at this rate was forced into the tank by a propeller fan in a suitable housing on the ground surface.

The maximum rate of use of solvent over short-time periods at the work bench or at the wall would require ventilation at a rate of some 60,000 cfm. This calculation indicated clearly the need for special air distribution means, otherwise workers would be exposed at times to concentrations several times the overall average in the space.

Bench

The arrangement selected to accomplish effectual results at the work table comprised a local exhaust system in the form of slots on each long edge communicating with an exhaust plenum chamber under the bench. The chamber was exhausted by means of a propeller fan at one end, which discharged the air out into the space adjoining the work bench, mixing it effectively with surrounding air. Fig. 5 and 6 illustrate the arrangement.

An air flow rate of 100 cfm per square foot of bench area was indicated on the basis of principles and experience with local exhaust for tanks and the like. A specification requiring a propeller fan of 6000 cfm capacity was laid down from these considerations.

Walls and Floor

For mixing of vapors originating at walls or floors where cement was applied, a similar arrangement was evolved, although the mechanical form was quite different. Several portable exhaust plenum chambers with slots and propeller fans were constructed in such a manner that when fastened to the portable staging they formed a practically continuous slot on each side of the 6-foot wide space. The vertical wall in this case corresponds to the bench top and the two slots flanking the wall area act to exhaust air laterally across the surface exactly as at the work bench. The propeller fans fling the contaminated air outward, mixing it with the surrounding atmosphere. (See Fig. 7.)

Test Results

After the equipment had been constructed and placed in operation, atmospheric analyses were made at several locations for comparison with the ventilation design concentration of 150 ppm.

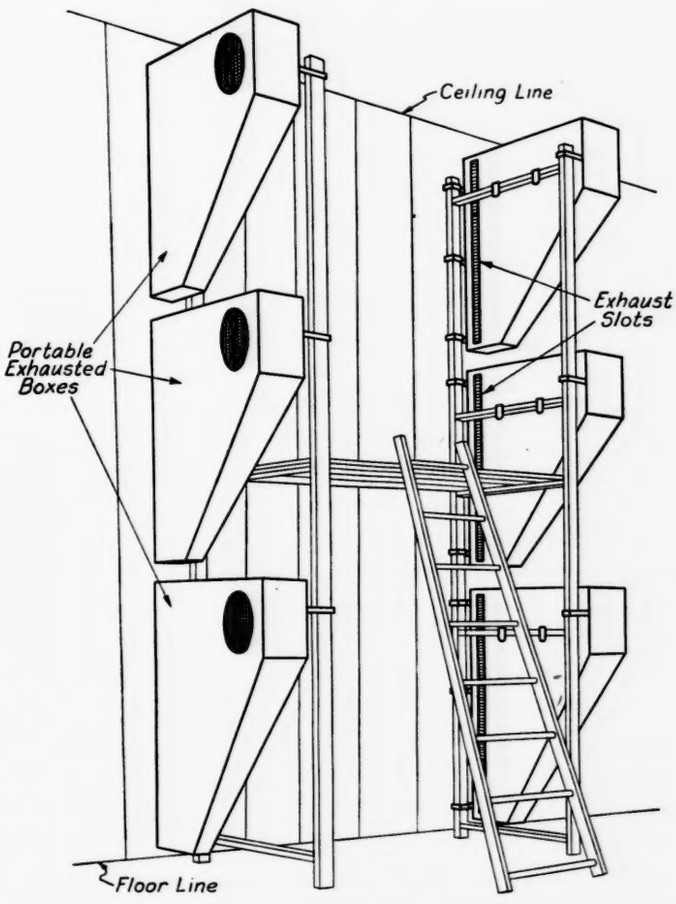


Fig. 7. Portable exhaust arrangement for displacement of solvent vapors in lining of wall. Vapor is withdrawn through slots and discharged, well diluted to adjoining space. General ventilation of space is not illustrated.

Sample Location	Average Concentration Methyl Ethyl Ketone, ppm Test 1	Test 2 (1 month later)
At table during application of cement	130	120
At wall or floor during application	150	100
General air at distance	110	120
General air nearer sources	110	80
Exhausted air from table	400	...

The small differences in concentrations near the source of vapor and in the general air at a distance bear testimony to the effectiveness of the distribution system. The fact that no concentrations exceeded the ventilation design concentration of 150 ppm proves that the preliminary estimate of the rate of evaporation was accurate. That had been the only uncertain factor. It was a foregone conclusion that the concentrations would be as predicted if the assumed use rate were realized.

The design of this ventilation system was developed in collaboration with Mr. T. M. Knowland of the Boston Woven Hose and Rubber Co., Cambridge, Mass.

Engineering Control of Welding Exposures

B. F. POSTMAN

Industrial Hygiene Engineer*, Employers Mutual Liability Insurance Co.

Much has been written about the exposure of operators to toxic and nuisance contaminants dispersed from electric welding operations. Little has been published covering the field experience of recommended local ventilation design data, such that the results of this experience, possibly with some modifications, may be utilized for future designs. The accompanying article is primarily concerned with the practical aspects of developing and applying effective controls for welding procedures which are a part of general shop operations. These may include small bench welding, or large shop operations involving the use of positioning machines as differentiated from operational procedures performed in ship work.

THE contemplated control of welding procedures may be necessary for protection against exposures resulting from volatilization of galvanized surfaces, volatilization from surfaces which have been coated with paint containing lead, mercury, cadmium, antimony or arsenic as ingredients, or volatilization from surfaces plated with chrome, cadmium or other metals which may be harmful to the health of welders. Furthermore, the control may be necessary for protection against the inhalation of materials volatilized and dispersed from coated welding rods. Due to the variability of work being handled in normal shop operations, there are bound to be occasions when a welder may be unnecessarily exposed to the inhalation of harmful substances. It may therefore be axiomatic to state that adequate engineering control should be provided for all welding operations. This is not only in accord with good industrial practice but conforms to statements made by recognized medical and engineering authorities.

After it has been deemed necessary to provide engineering control, then the question naturally arises as to the cost of such control. Such cost must be predicated on the type of ventilation to be utilized for the installation under consid-

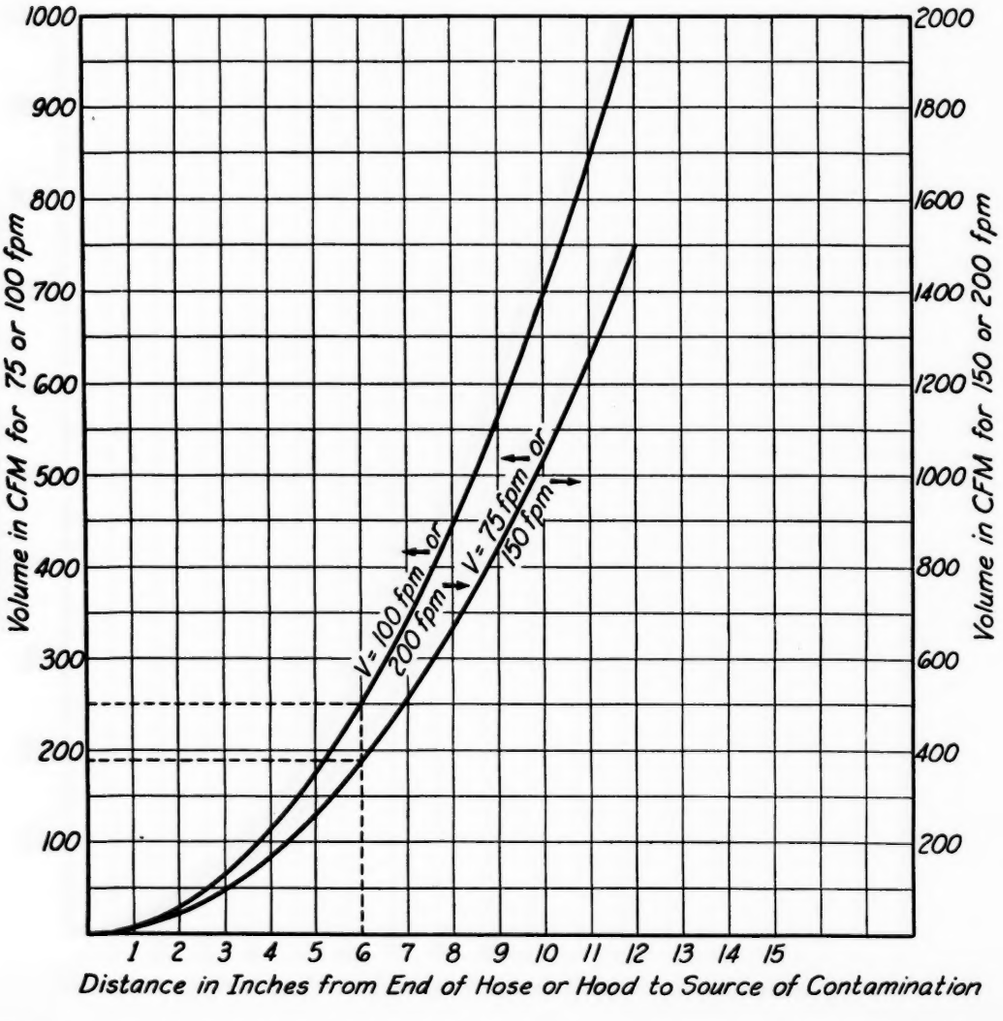


Fig. 1. Solution of $Q = 10Vx^2$ for V = 75, 100, 150 and 200, showing air flow requirements for control of welding fumes. The preferable *minimum* control velocity at source of contamination is 100 fpm.

*Formerly Captain, Sanitary Corps —Army Industrial Hygiene Laboratory, Edgewood Arsenal, Edgewood, Md.

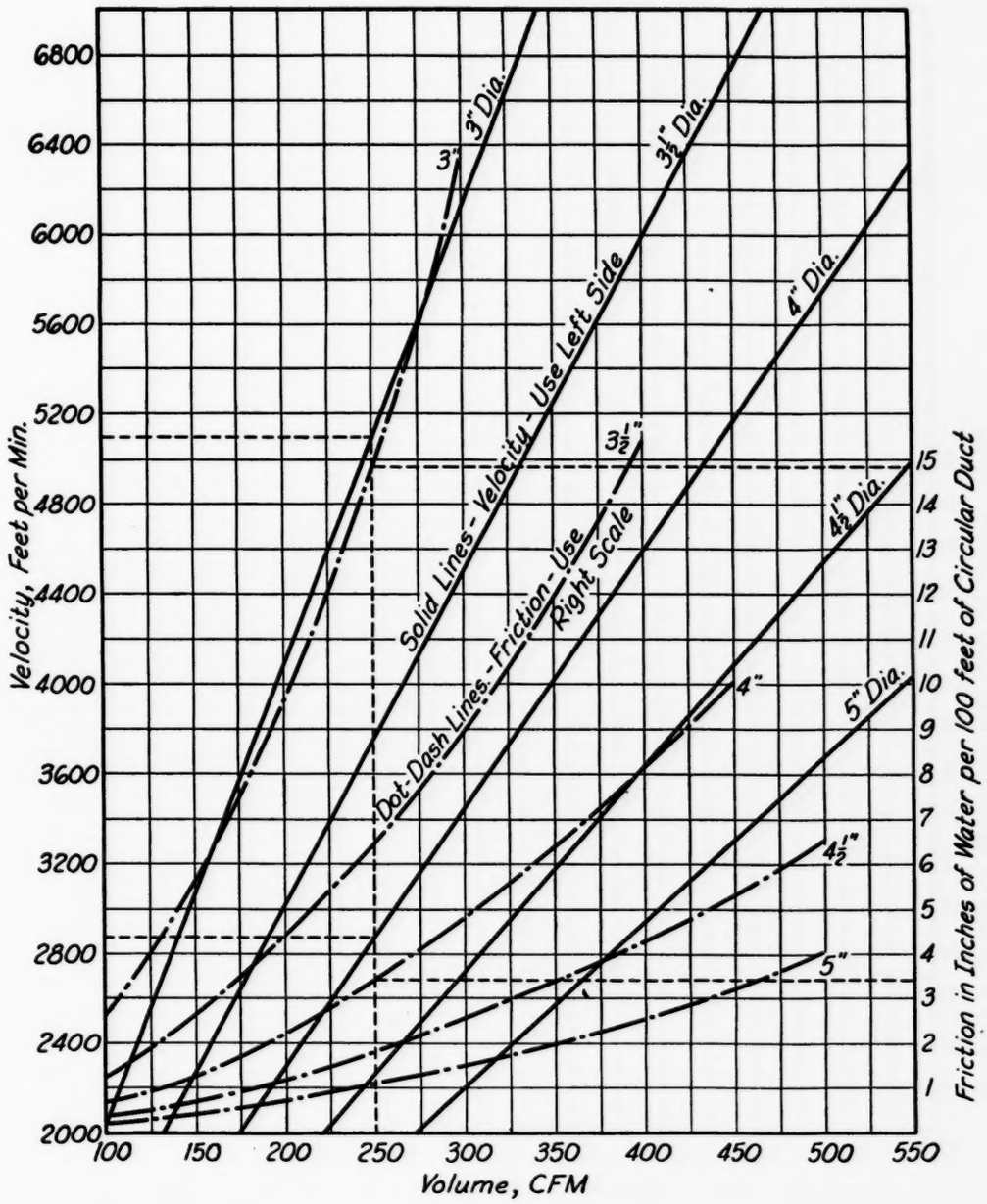


Fig. 2. Chart for determining velocity and friction loss in metal ducts of various diameters. Knowing cfm, use solid curves and read velocity on left scale; use dot-dash curves and right scale to find friction.

eration. The first reaction is to suggest so-called general exhaust ventilation—to be provided by the use of propeller fans located in the side walls or in the monitor roof section of the building.

General exhaust ventilation for shop welding operations removes entirely too much air and therefore too much heat from shop areas. This is a major problem affecting all industrial exhaust ventilation during the winter heating period. Besides, once general dispersion results throughout an area, it is indeed difficult effectively to ventilate such an area. The problem then narrows down to providing local exhaust ventilation for all welding operations. It is with this phase of the problem that the present article is concerned.

There are seven factors which should be considered in the design of any local exhaust system to be developed for the control of dispersion from shop welding operations. These are:—

(1) Air quantity to be exhausted from each welding station;
(2) Shape, size and arrangement of the welding hood;
(3) Type, size and length of flexible hose to be used between the welding hood and the branch exhaust connection;
(4) Type and capacity of the exhaust fan unit;
(5) The problem of recirculating air from the welding station to the general work area;
(6) Adaptability of the contemplated system from the viewpoint of interference with the maneuverability of the welder or reduction in his production, or both; and
(7) Personalized and continuous instruction of the welder to "sell" him on the necessity for using the installed control.

These items will be discussed in detail.

Air Quantity

The location of the exhaust hood relative to the source of dispersion, i.e., the welding torch, and the minimum control velocity desired at the operation, determine the air quantity to be exhausted from a welding station.

Air quantity is based on the Dalla Valle equation:—

$$Q = V\,(10\,x^2 + A)$$

where Q = cfm of air to be exhausted,
V = control velocity, fpm, at the source of dispersion,
x = distance, ft, from hood to source of dispersion, and
A = area, sq ft, of end of hose or hood.

Since some limiting factors must be selected, 6 in. and 100 fpm have been assumed as the distance of the hood from the welding torch, and the control velocity desired to be maintained at the source of dispersion. Since A is small, it may be eliminated from the equa-

tion. By substituting the assumed values, the resulting required air flow is found to be 250 cfm.

Though some engineers recommend a control velocity of 75 fpm, field experience demonstrates that drafts in the working area easily upset the effectiveness of the installed control. It is on this basis that 100 fpm has been selected as the minimum control velocity.

As an aid in determining air flow requirements for welding or for other point source dispersions, the curves in Fig. 1 have been developed. Four control velocities are indicated, which, with the variation in hood location, will readily determine the air flow without too much effort. A few examples will illustrate.

(1)—*75 fpm control velocity, hood located 6 in. from welding operation.*

The 75 fpm curve, using left scale, indicates that 190 cfm will be required to provide control at the indicated distance. If the hood is moved to a point 8 in. from the welding torch, without changing the desired control velocity, the required air flow will be 335 cfm—an increase of 76%.

(2)—*100 fpm control velocity, hood located 6 in. from welding operation.*

The required air flow will be 250 cfm. By changing the hood location to 8 in., control velocity to remain the same, the air requirement will be 445 cfm—an increase of 78%.

These figures are significant as they indicate why some welding control installations are not functioning properly. It may be the result of insufficient air flow, hood located too far from the source of dispersion, and/or, usually, insufficient suction at the fan with the corresponding lack of adequate motor power.

Fig. 4. Electric welding repair of stainless steel baskets. Note fume dispersion to the general work area when controls are off.

The reason for using the distance 6 in. instead of 8 in. or 10 in. is to reduce the quantity of air to be

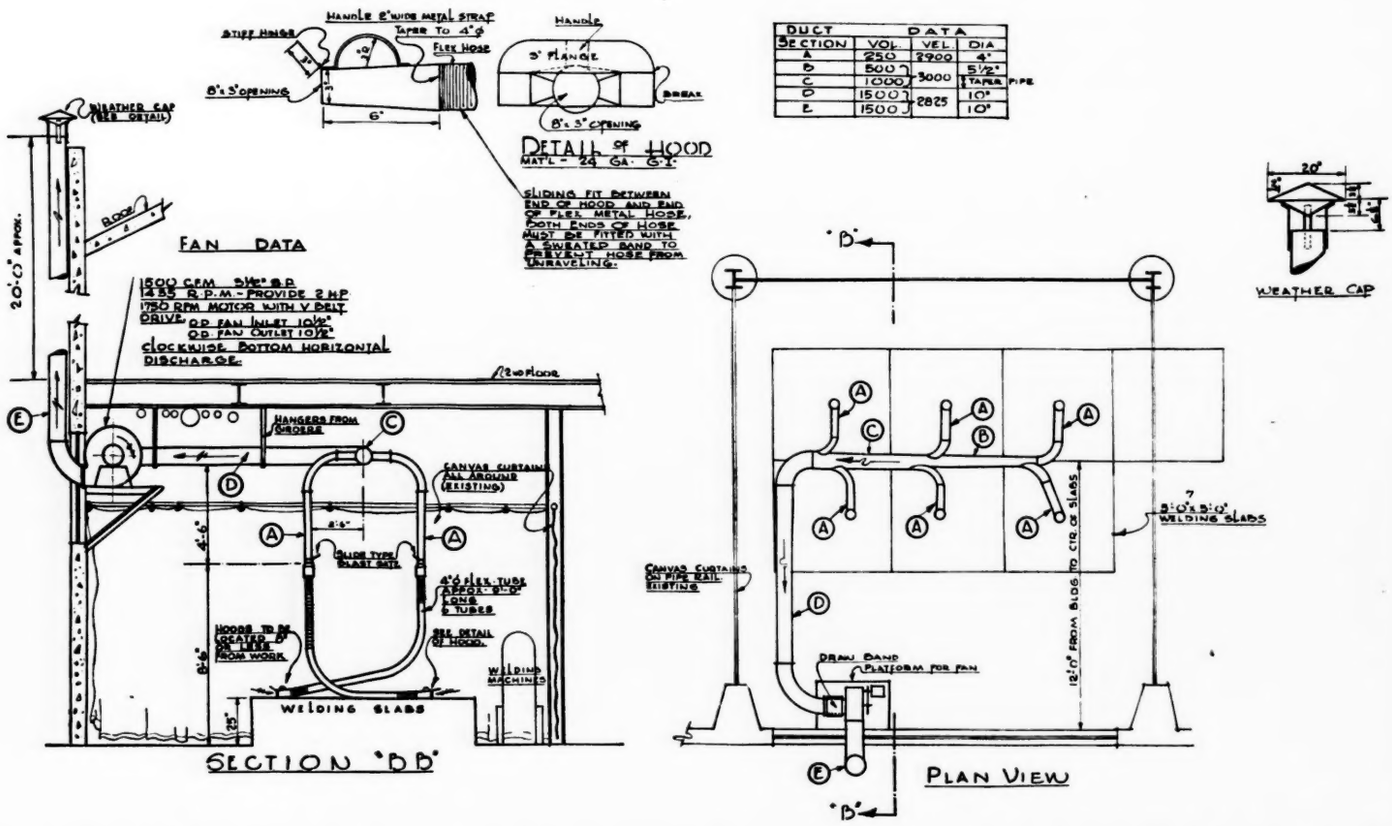

DUCT DATA
SECTION VOL VEL DIA
A 250 2900 4"
B 500 3000 5½"
C 1000 3000 8" TAPER PIPE
D 1500 2825 10"
E 1500 2825 10"
HANDLE 6" WIDE METAL STRAP TAPER TO 4"ø
STIFF HINGE
FLEX HOSE
6" FLANGE
HANDLE
8"x 3" OPENING
6"
BREAK
8"x 3" OPENING
DETAIL OF HOOD
MAT'L - 24 GA. G.I.
SLIDING FIT BETWEEN END OF HOOD AND END OF FLEX METAL HOSE, BOTH ENDS OF HOSE MUST BE FITTED WITH A SWEATED BAND TO PREVENT HOSE FROM UNRAVELING.
WEATHER CAP (SEE DETAIL)
BLOCK
20'-0" APPROX.
FAN DATA
1500 CFM @ 4½" S.P.
1455 R.P.M. - PROVIDE 2 HP 1750 RPM MOTOR WITH V BELT DRIVE.
OD FAN INLET 10½"
OD FAN OUTLET 10½"
CLOCKWISE BOTTOM HORIZONTAL DISCHARGE
2nd FLOOR
HANGERS FROM GIRDER
CANVAS CURTAINS ALL AROUND (EXISTING)
SLIDE TYPE BLAST GATE
4'-0 FLEX. TUBE APPROX. 8"-0" LONG & TUBES
HOODS TO BE LOCATED 6" OR LESS FROM WORK
SEE DETAIL OF HOOD
WELDING MACHINES
WELDING SLABS
SECTION "DD"
20"
WEATHER CAP
"B"
CANVAS CURTAINS ON PIPE RAIL (EXISTING)
DRAW BAND
PLATFORM FOR FAN
12'-0" FROM BLDG. TO CTR. OF SLABS
3'-0"x 5'-0" WELDING SLABS
PLAN VIEW
"B"

Fig. 3. Typical detail design for control of welding fumes. Dimensions are approximate; ducts to be 24 ga. G.I., riveted and soldered. Draw band or slip joint to be provided at fan inlet, and slide type blast gate for each hood.

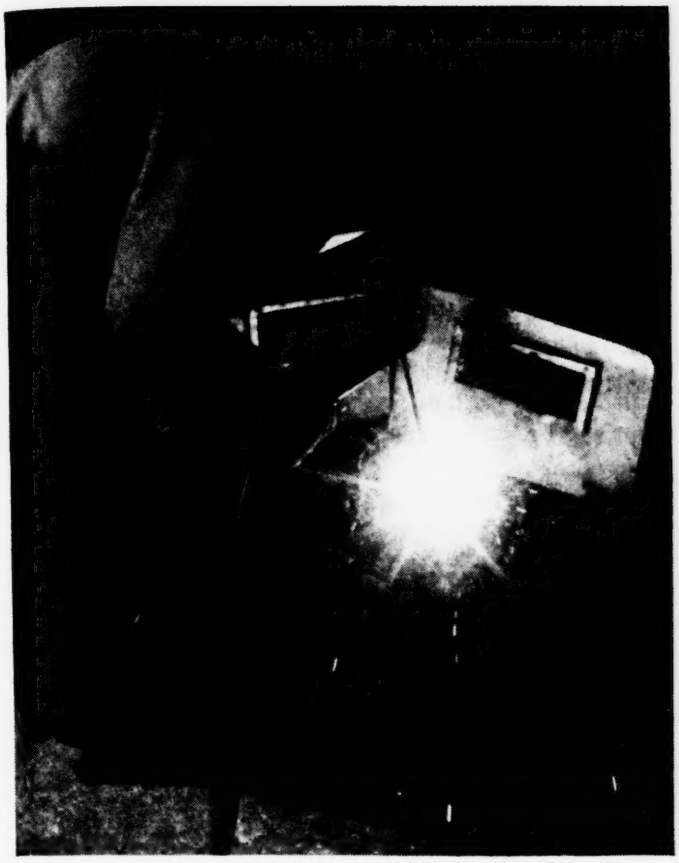


Fig. 5. Electric welding repair of stainless steel baskets. Note effectiveness of applied control in preventing fume dispersion to the general work area.

exhausted from each welding station, as illustrated in the examples presented above. Increased air flow may increase either the internal diameter of the flexible hose to be used, or using the same diameter hose, there will be an increase in the resulting friction loss which, in the final analysis, means increased motor capacity for the exhaust fan.

At any installation or operation where flexible hose is to be handled by the operator, the tendency is to reduce the size of the hose without any investigation being made to determine the effect on the reduced air flow. The curves shown in Fig. 2 have been developed to illustrate what happens when air flow and pipe sizes are promiscuously abused. Since test data are not available covering the friction loss through flexible hose, the standard friction data for equivalent diameter sheet metal ducts are utilized. The estimated resistance of the flexible hose is then evaluated as explained later under *Size and Length of Flexible Hose.* For welding installations, the author has predicated his designs on exhausting 250 cfm through a 4-in. ID flexible hose. Referring to Fig. 2, the velocity of the air flowing through 4-in. duct is 2870 fpm. If the hose is reduced in size to 3-in. ID (the usual installation) the resulting velocity of the air flowing through the hose will be 5100 fpm. The estimated friction loss for the two velocity conditions will be 3.4 in. per 100 ft of 4-in. duct and 14.85 in. per 100 ft of 3-in. duct, respectively. To some the increased friction loss is entirely justifiable even though it does increase the power required to operate the exhaust fan. To be sure the increased friction loss means a small inside diameter of hose which *may* be acceptable to the welder, for in the final analysis it is he and he alone who handles the hose. On the other hand *it is not good engineering economics to maintain such high air velocities in hose used for exhausting contaminants dispersed from welding operations.* Thus for the lower air velocity, i.e. 2870 fpm, it will be satisfactory to use a 4-in. hose which is heavier (1.350 lb per ft for 4-in. ID as against 1.015 lb per ft for 3-in. ID in one type of lightweight unpacked flexible metal hose) and less flexible than the 3-in. ID hose.

For shop installations where welding is performed at benches, tables, on the floor or at positioning machines, 4-in. ID hose is recommended. For ship welding operations, 3-in. ID hose is normallly used as it is more flexible and may be more easily handled.

Welding Hood

Reference will only be made to shop welding operations. Since a welder usually welds a section 8 or 9 in. in length before he breaks his arc, the fish-tail type of exhaust hood shown in Fig. 3 was developed. This hood is provided with a rectangular inlet 8 in. x 3 in. With air air-flow of 250 cfm, the entrance or face velocity at the hood opening is 1500 fpm.

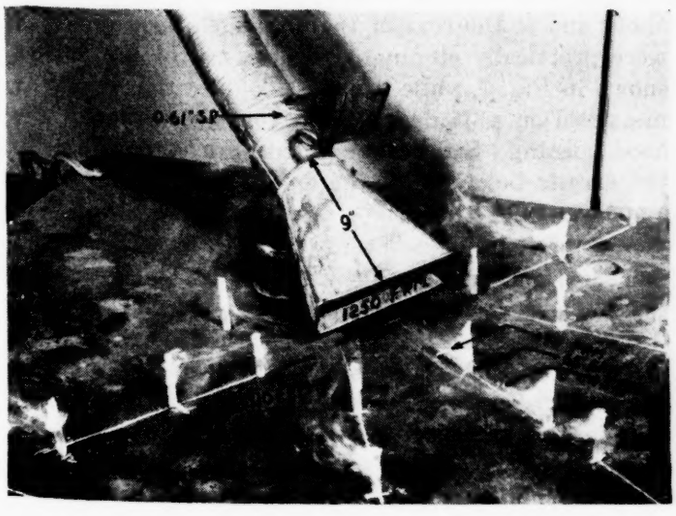


Fig. 6. Air flow test of fish-tail type exhaust hood without flanges.

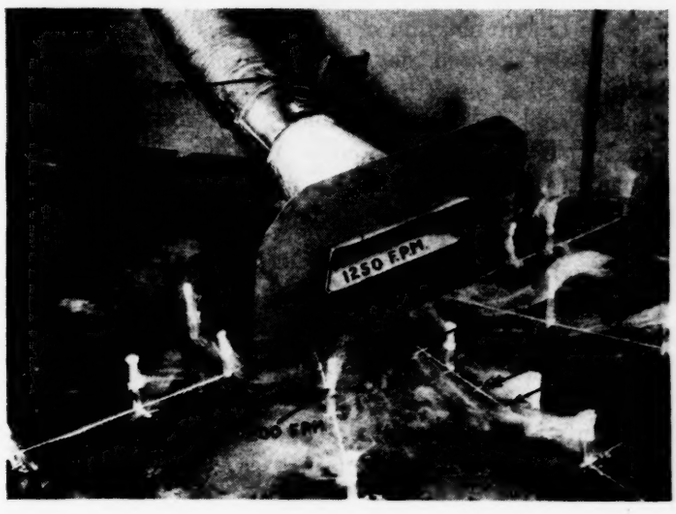


Fig. 7. Air flow test of fish-tail type exhaust hood complete with flanges on all four sides of inlet.

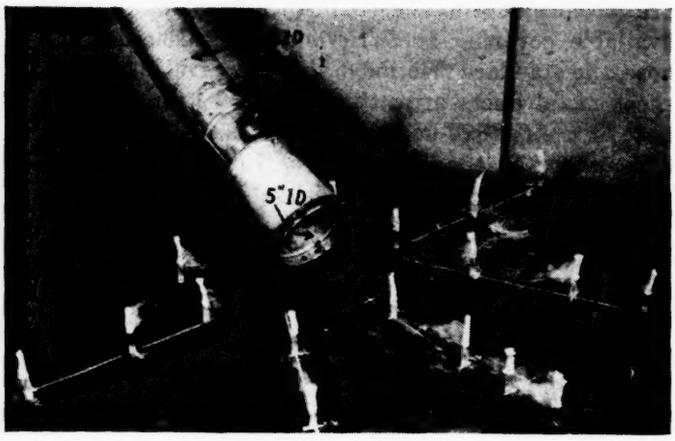


Fig. 8. Air flow test of circular type exhaust hood without flange.

Fig. 3 illustrates a design of a welding installation, complete with hood, piping details and exhaust fan requirements. Flanges were provided for three sides of the hood opening. Experience has demonstrated that it is preferable to provide flanges on all sides of the hood opening since in the majority of cases welding is performed at distances 4 to 8 in. from the top of the table or bench. The operator will not be very cooperative at first, to the extent of moving the hood as he progresses with his welding. However, the newness of the device and its apparent clumsiness are soon overcome, once the operator realizes that the installed control is for his protection.

A recent design was developed for a local exhaust system to control exposures from nine welding stations located in four welding enclosures. The airflow requirements were based on 200 cfm, to provide a control velocity of 75 fpm at the welding torch which was to be located 6 in. from the face of the exhaust hood. Though the control of welding fumes was apparently adequate with the imposed 6-in. limitation, it seemed desirable that future designs should be based on 250 fpm to provide a control velocity of 100 fpm at the source of dispersion, 6 in. from the exhaust hood. Draft from open doors and windows had a tendency at times to whip the fumes away from the exhaust hoods.

The area of maximum fume dispersion occurred at the station located nearest the exhaust fan, where stainless steel mesh baskets were repaired or rebuilt. Though each of the four welding enclosures was provided with two exhaust hoods (the last enclosure contained three hoods) and flexible metal hose branch connections, the operators did not seem to favor the use of the installed controls.

It was then that personalized instruction was attempted. This method of approach proved fruitful. Each operator was given a general outline covering the need and desirability for the installation of the system, i.e. to remove nuisance and harmful contaminants from his breathing zone, special stress being placed on the distance factor involved. Welding was then started. The hood was slowly moved away from the welding zone until the dispersed fumes were beyond the zone of influence of the hood. Welding was then stopped. It was found that the location of the hood in reference to the location of the torch varied from 9 to 11 in. depending on local air disturbances. The operator was then instructed to locate the hood 6 in. or less from the torch, depending of course on the type of job being welded. Two hoods were used for heavy work, particularly when welding was performed on stainless steel. Previous to the installation of this system, fume dispersion from stainless steel welding operations permeated the entire shop area. Typical dispersion is shown in Fig. 4, "Control off." Fig. 5, "Control on," illustrates the effectiveness of the installed control. All of the welding fumes were removed from the breathing zone of the operator.

Note the wire mesh which was provided over the rectangular openings of the exhaust hoods. It was found that this protection was necessary. Rags, paper lunch bags, gloves or caps were usually found in the nipple connection between the branch and the main exhaust line. In one booth a handkerchief completely blocked the opening to the main exhaust line, necessitating the removal of the hood and flexible metal hose before the cause for the lack of suction was discovered.

An interesting set of photographs is shown in Fig. 6 to 9. Those very evasive "trained arrows" which everyone talks about but which are rarely seen, were finally captured and photographed as they cavorted about in front of and into the exhaust hoods. The smoke ampules used for these photographs contained ¼ cc. of titanium tetrachloride.

Fig. 6 shows the action of the air currents about the fish-tail exhaust hood without any flanges. Air velocity readings were taken with the heated-thermometer anemometer. An inspection of Fig. 7, which shows the hood complete with flanges on four sides of the opening, clearly indicates how the air currents were concentrated into a zone of increased effectiveness. As stated previously, the design control velocity, 6 in. from the face of the hood, was 75 fpm. The resulting control velocity for the unflanged hood, measured along the center line of the hood axis was found to be 65 fpm. With the flanges shown in Fig. 7, this control velocity increased to 85 fpm, an increase of 31%. It is interesting to note that high velocities above and to the rear of the unflanged hood in Fig. 6 were practically eliminated by the use of the flanges shown in Fig. 7, while it almost doubled the velocity as measured on a 45 degree line from the corner of the hood opening. Stray air currents are responsible for the erratic behavior of the smoke from some of the ampules.

A somewhat more interesting result may be seen in Fig. 8 and Fig. 9. The circular exhaust hood was used only as an experiment for air flow distribution. It was found that this type of hood did not meet with the practical requirements of the operators as did the fish-tail type of hood. It may be noted in Fig. 8 that considerable air velocity is indicated at the last smoke ampule located on the extension of the hood center line. This ampule is located 18 in. from the face of the hood.

The circular flange shown in Fig. 9 aided, though not as effectively as the flange shown in Fig. 7, in

concentrating the air flow in a sort of enveloping movement in front of the hood opening. In actual practice a square flange would have been used.

The rectangular flanges finally installed on all fish-tail exhaust hoods had the upper flange curved forward, the curve starting from the upper edge of the hood opening. This type of flange seemed to be more effective than the straight flange.

These photographs demonstrate more dramatically than words can describe, that suction applied to a hood or opening quickly loses its effectiveness as the source of dispersion or contamination is moved away from the source of suction.

With slight modifications, the type of exhaust hood illustrated may be used advantageously for soldering and brazing operations. This is of particular importance where so-called silver soldering is performed on cadmium with the use of fluoride fluxes.

The size, i.e. the inside diameter of the flexible hose used for exhaust from welding operations, has been fully discussed under *Air Quantity* to the effect that for general shop operations 4-in. ID hose is preferable.

Size and Length of Flexible Hose

The length of flexible hose sections should be kept as short as possible consistent with the type of welding operation being performed. If the major portion of welding is performed on a bench, table, or in a positioning machine, then short sections of flexible hose may be used very advantageously. If an occasional job is welded on the floor it may be necessary to provide a long hose connection which should not be used when a table or bench job is being worked on.

Friction losses in flexible rubber or metal hose have not been evaluated to the extent that any published data may be used with safety. One engineer states that the friction loss of flexible metal hose is 15% greater than that for straight sheet metal pipe of equivalent diameter. Another engineer states that this factor should be increased to 25%. The author doubles the friction loss of straight pipe to evaluate the friction loss for flexible metal hose of equivalent diameter. This may be high but field tests and evaluations of cfm and static pressure of many systems seemed to check fairly well with the design data. The eventual contortions that long lengths of flexible metal hose may be twisted into by operators, are indeed beyond comprehension.

Type and Capacity of Exhaust Fan Units

For the normal run of welding systems controlling a few stations, a CI full-housed V-belt-driven fan unit may be selected. Static pressures may range from 2½ to 5 in., depending on the system design and the velocity maintained in the branch connections and main exhaust line. It may be advisable to add one or two additional welding stations to the fan capacity selected, since it is not unusual to add stations to a system after it has been installed. The additional air quantities are so small, that in a majority of cases, the resulting motor horsepower will not even be affected.

It is not considered good industrial practice to recirculate air exhausted from welding operations due to the possible contaminants which may be present in the effluent air. However, where welding operations are performed in the center of large working areas, it may be impossible, due to overhead cranes or structural interferences, to discharge air from welding operations to the outdoors. Under the circumstances, there may be two methods of air disposal:

(1) Provide a high stack from the fan outlet, such that the effluent air will be discharged at high velocity towards the underside of the building structure. In this manner, the small amount of contaminated air will be diluted by the larger volume of air within the building proper. Nevertheless, dilution does not remove these contaminants from the work area.

(2) Provide a discharge stack from the fan outlet, extend this stack up along an adjacent column and then discharge the contaminated air within the building as outlined under (1) or which is more desirable, continue the stack through the roof and discharge the air to the outdoors.

The problem of heat conservation as it applies to exhaust air from normal welding operations is not thought to be a serious industrial problem. Where attempts are being made to exhaust large quantities of air by means of downdraft ventilation, for the control of exposures from welding operations where large positioning machines are involved, then the heat factor may become a serious problem. It is then that the problem of heat conservation and air recirculation should receive the consideration they deserve.

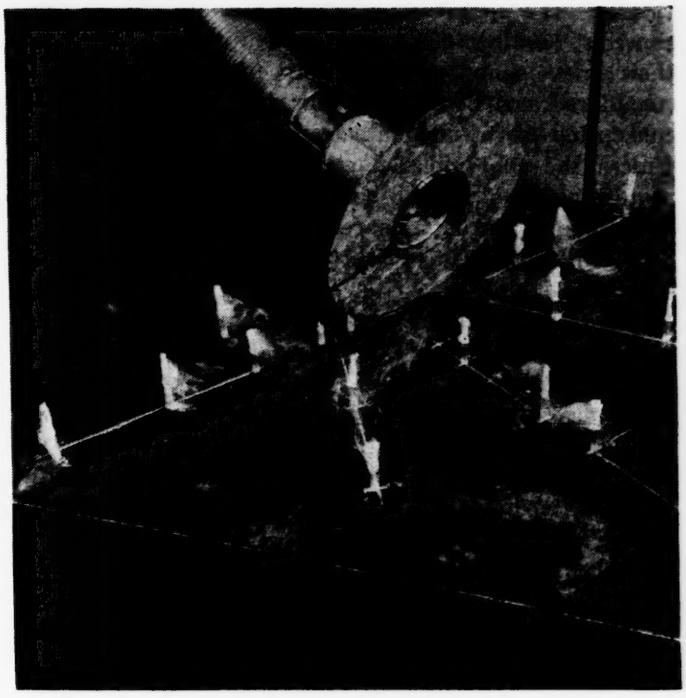


Fig. 9. Air flow test of circular type exhaust hood complete with flange.

Adaptability of the Installed System

No matter how careful a design is developed, no matter how much is spent on an installed system for the control of exposures resulting from welding opera-

tions, if the operator or operators refuse to use the controls because they are unwieldy, interfere with their movements, reduce their productivity or are considered as just another "gadget", then the original conception of an adequate control has sadly misfired. Unless the contemplated control meets not only the requirements of the job but also those of the operator, even though the latter's requirements may be biased or based on ignorance, then the control will become an economic debit.

However, there are ways of overcoming many of the objections, real or imaginary. Manufacturing procedures may be revamped, the location of the operations may be changed and finally operator education may be attempted.

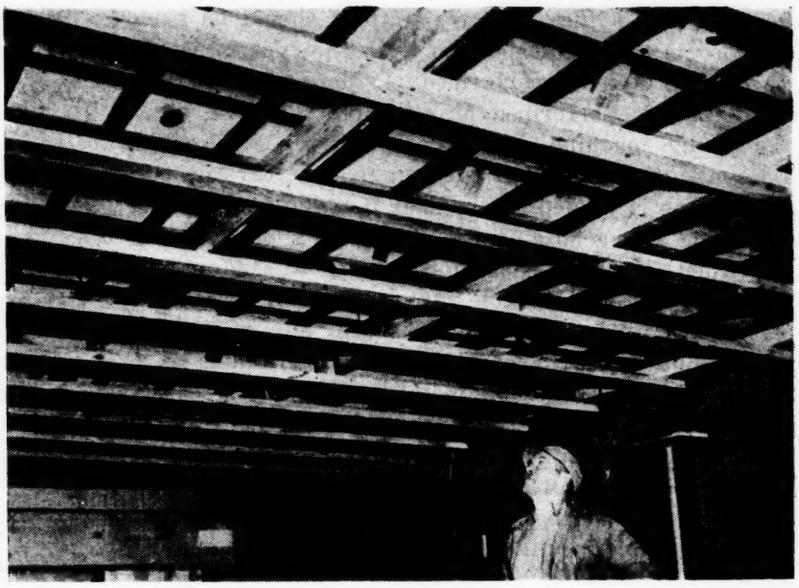
Personalized operator instruction is the most important item for the successful application and utilization of any type of control which is as intimately related to a worker as a movable welding hood is to a welding operator.

Simple, adequate and continuous instruction must become a part of every system designed for the control of exposures resulting from welding operations. One successful method of approach has been previously discussed under the item *Welding Hood*. If it has been successful in one plant, it can be successfully applied in other plants.

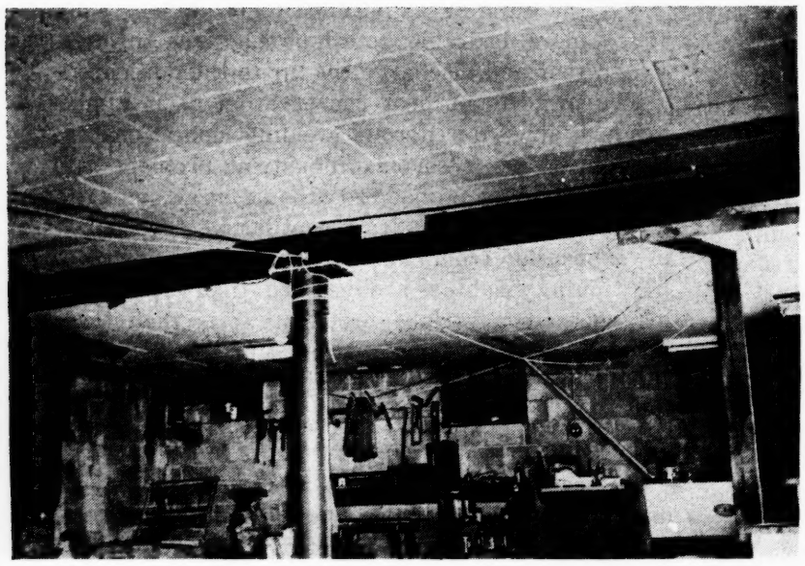
From the data submitted it has been shown that such facts as air quantity, hood design, distance of hood from source of dispersion, diameter of flexible hose, fan capacity—all have a bearing on the design and effective operation of a local exhaust ventilation system for the control of dispersion from welding operations.

Radiant Heating Under Hardwood Floor

Pipe for the conventional radiant heating system was hung from 2 x 8 in. joists under a completed hardwood floor of a residence in Cooperstown, Pa. After pipes were in position, 2 x 4's were nailed on edge to the bottom of the joists, between the pipes. Other 2 x 4's were fastened to these bottom edges to form sleepers, resulting in 12 in. air space between the sub-flooring and the sleepers. A layer of aluminum coated insulating paper was tacked on top of the sleepers, and another layer of the coated paper was placed on the bottom forming a 2-in. air space between the insulation. Finally ¾ in. semi-rigid insulation board was nailed to the underside of the sleepers in direct contact with the aluminum-coated paper. Circulation through the pipes was insured by a small pump on the return main. A hand-fired coal boiler supplied 140F water. In calculating the amount of pipe required, a heat transfer coefficient of 1.75 was used, or one-half that for pipe installed in concrete floor slabs.



(Right) Pipe and sleepers in place before insulating board was placed.



(Below) Insulating board hides the piping that provides heat for first floor and basement.

The Comfort Bonus of Insulation

Wall insulation and double windows affect the economy of heating not only by reducing heat loss from room air through walls but also by making possible lower comfortable ambient air temperatures.

THE fuel-saving advantages of building insulation and double windows are well known not only to engineers, architects, and builders but to laymen as well. However, the engineer is, perhaps, a step ahead of the other groups in appreciating the importance and advantages of such insulation in reducing the inside wall surface temperature.

On the other hand, although he appreciates the point, the engineer has had, in most cases, no method of measuring quantitatively the effect of the inside surface temperature on the physical environment and, consequently, on the comfort of the occupants. This discussion describes a method of evaluating this factor which is affected by the use of building insulation and/or double windows. Any increase in comfort is, of course, in addition to the fuel savings, so that it is a plus or bonus value received by the building occupant.

Operative Temperature

The four major factors which influence one's feeling of comfort insofar as heat is concerned are (1) air temperature, (2) humidity, (3) air motion, and (4) radiant temperature of the environment. Experiments at the Harvard School of Public Health showed that subjects were unable to detect changes in humidity between 30% and 60% at ordinary room temperatures. Since this is the usual range of living space humidities, the factors of concern here are thus reduced to three.

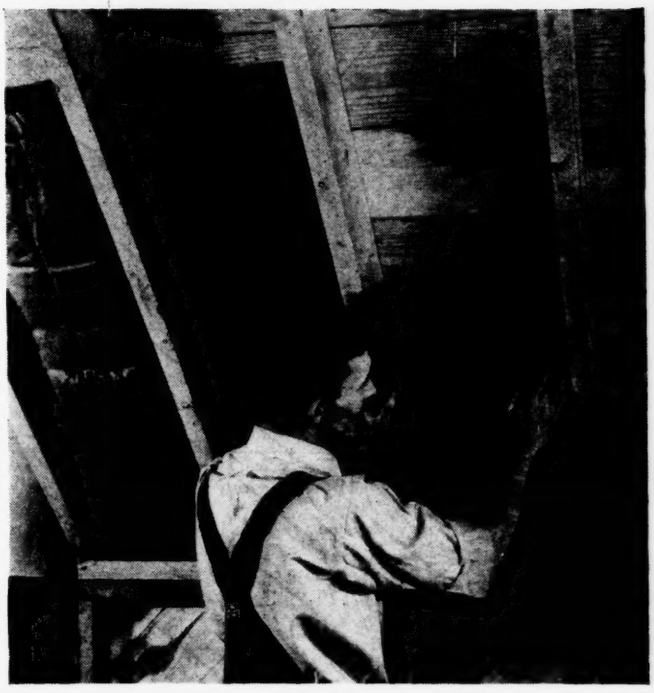
The factor of radiant temperature is a somewhat complicated one. The mean radiant temperature depends not only on the temperature of all the enclosing surfaces, but on the relative importance of each in its effect on body heat loss. An accurate determination of the MRT involves the exact positions and distances of the human body relative to the surfaces. A less accurate method (but sufficiently accurate for working purposes) is to use for MRT an average of the temperatures of the surfaces weighted according to the areas of the respective surfaces.

Thus the mean radiant temperature, t_r, of a room is

$$t_r = \frac{A_g S_g + A_w S_w + A_p S_p + A_f S_f + A_c S_c}{A_g + A_w + A_p + A_f + A_c}$$

where A_g, A_w, A_p, A_f, and A_c are the areas of outside glass, outside wall, inside walls or partitions, floor, and ceiling, respectively, and S_g, S_w, S_p, S_f, and S_c are the inside surface temperatures of outside glass, outside wall, partitions, floor and ceiling, respectively.

A paper by Gagge (1940) defined the relationship among air temperature, radiant temperature of surroundings, and air motion. The relationship is expressed by the term operative temperature — which describes the combinations of factors providing a constant thermal environment.



Insulation affects both heat loss and comfort.

The formula is:

$$t_o = \frac{21.3 + 0.533\, t_r + \sqrt{V}\,(0.121\, t_a - 5.5)}{0.752 + 0.064\sqrt{V}}$$

where t_o = operative temperature, F,
t_r = mean radiant temperature, F,
t_a = air temperature, F,
V = air velocity, fpm.

By the foregoing equation, any combination of t_a, t_r and V which produces the same t_o as another combination will produce an equivalent physical environment. Comfort is not involved directly, for Gagge and his coworkers did not attempt to measure sensations of warmth or cold. It seems reasonable to believe, however, that within limits an operative temperature from one combination of the variables may be equally comfortable with another set giving the same t_o. If this assumption is correct, then, if extreme variations are excluded, we can say that the heating system should produce an operative temperature which the occupant finds comfortable, and t_a, t_r and V can be varied (within limits) so long as their net result in t_o remains fixed.

Most living quarters have so-called "still air" conditions, usually defined as 15 fpm air velocity. Conse-

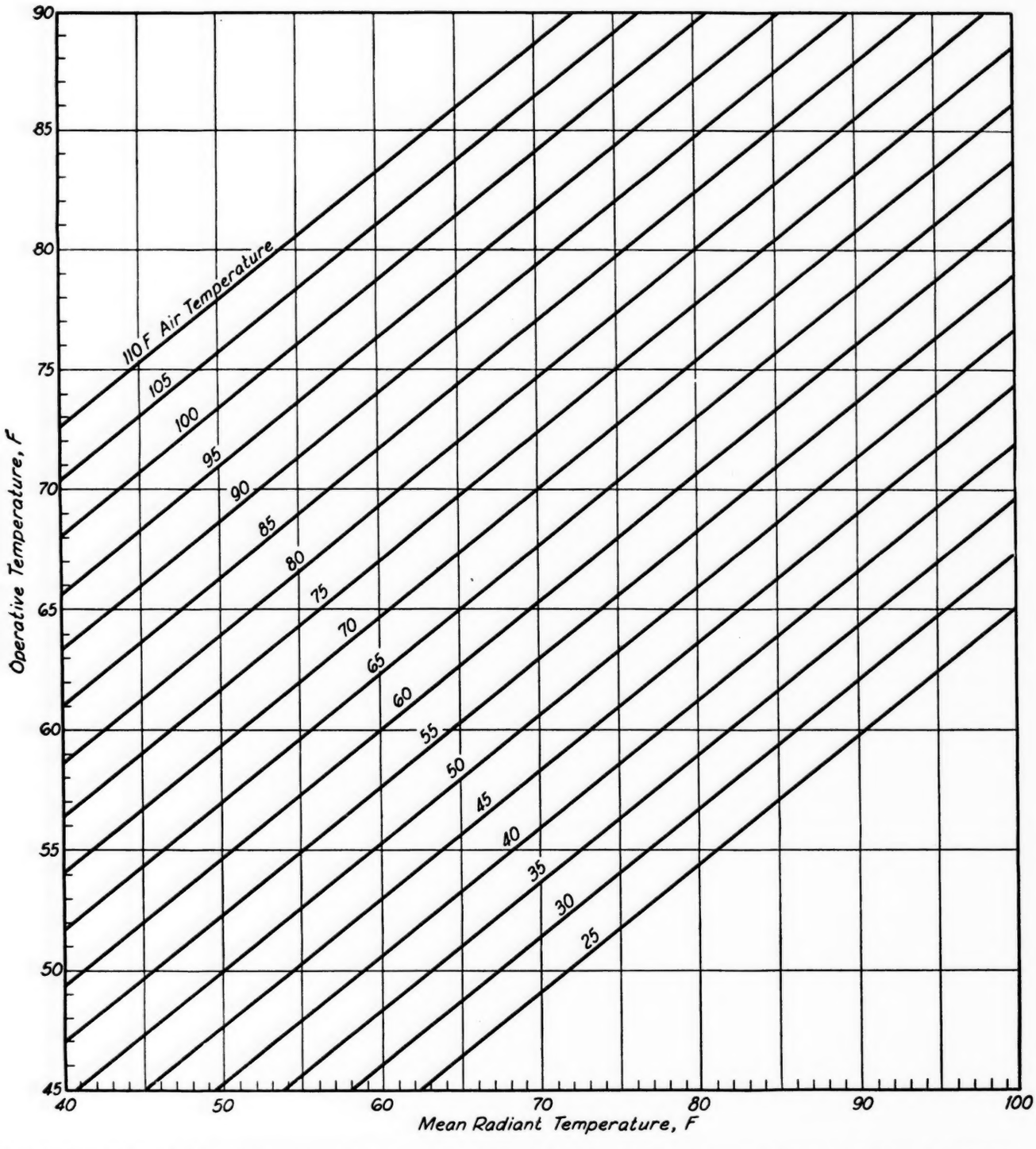


Fig. 1. Graphical solution of the equation for operative temperature for "still air" spaces where air velocity is 15 fpm.

quently, for these "still air" spaces, t_o can be expressed in simpler form as:

$$t_o = 0.533\ t_r + 0.467\ t_a$$

when $V = 15$.

A graphical solution of this equation is given in Fig. 1.

If t_r and t_a are both 70F, then

$$t_o = 0.533 \times 70 + 0.467 \times 70 = 70.0$$

so that in living quarters, for people more or less at rest, the value of t_o is at least close to the conventional air temperature we try to maintain.

The foregoing conception that the function of the heating system is to maintain a fixed operative temperature can perhaps safely be expanded to say that this operative temperature will probably be reasonably close (say $\pm$ 5F) to our usual ideas of comfortable temperature.

The equation for operative temperature explains why, with a thermostat set at a fixed temperature, we feel chilled on a very cold night. The inside surface temperature of the outside wall has dropped so that t_r has dropped. To maintain the t_o we find comfortable, the decline in the value of t_r must be compensated for by re-setting the thermostat to a higher t_a value.

The following calculations show the extent of this required elevation of air temperature, and how it is sharply affected by insulation or double glazing.

For purposes of discussion, let us assume a group of room occupants who on the whole feel comfortable at a $t_o = 71F$. Let us further assume that we are considering a room 10 × 10 × 10 ft, with two walls

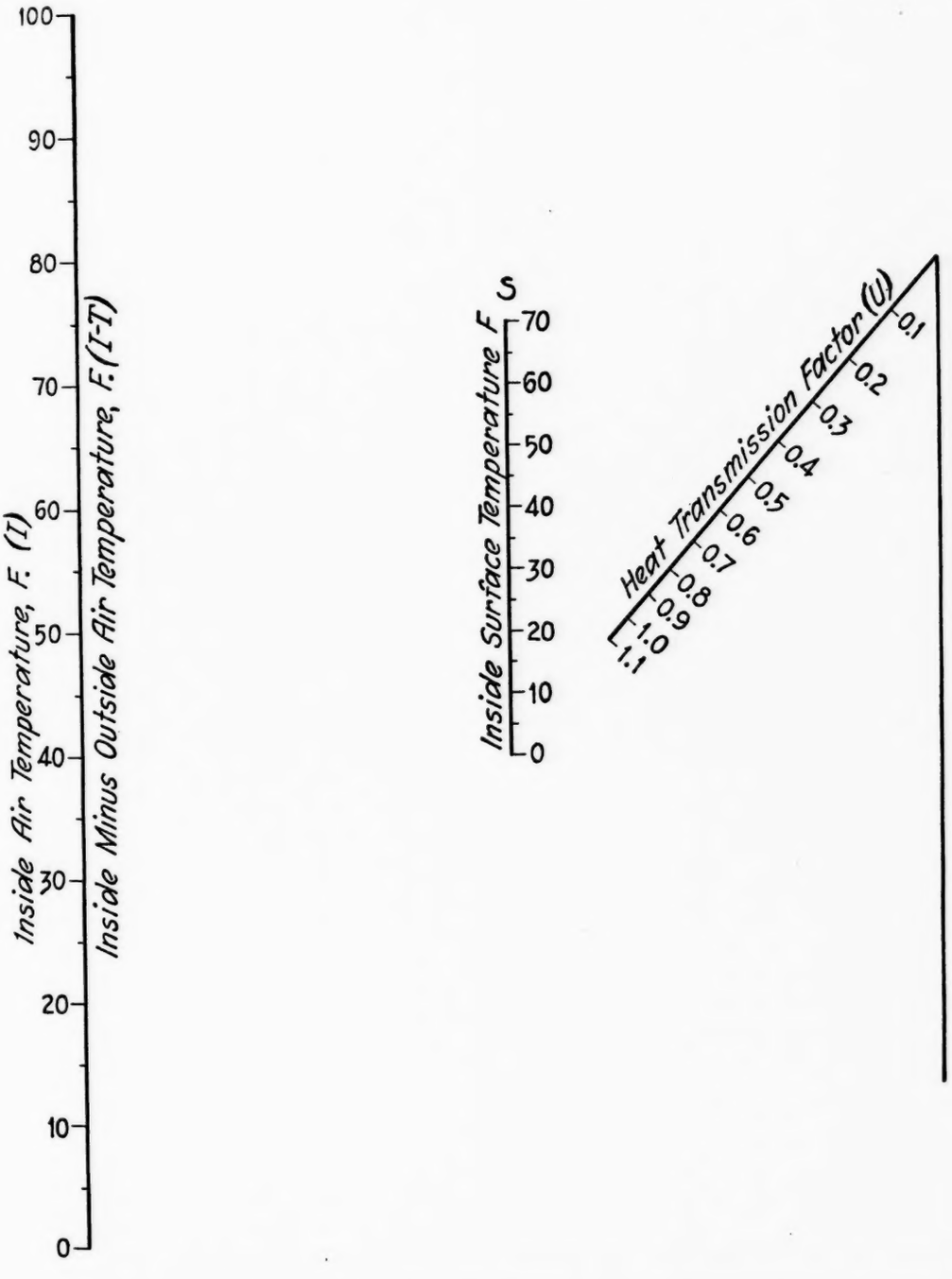


Fig. 2. Chart for determining inside wall surface temperatures. ***Example:*** **Assume an inside air temperature (I) of 75F, an outside temperature (T) of 25F and a heat transmission coefficient (U) of .7. What is the inside wall surface temperature?** ***Solution:*** **(I — T) = 50. From 50, inside left scale, through 0.7 on the sloping (U) scale, draw a line and mark its intersection with the unscaled line at the right. From this intersection draw a line to 75 on the left scale (I); the intersection of this line with the center vertical scale shows a wall temperature (S) of 55F.**

exposed, and with inside walls, floor and ceiling at room air temperature. The outside walls have a *U* (heat transmission coefficient) of 0.32, and contain single windows totaling 50 sq ft with a *U* of 1.1. The inside surface temperature of the outside walls can be determined by the formula

$$S = I - \frac{U}{1.75}(I - T)$$

where S = the surface temperature, F,
I = inside air temperature, F,
U = heat transmission coefficient, Btu per sq ft per hr per F, and
T = outside air temperature, F.

A graphical solution of this formula is given in Fig. 2.

Now assume an air temperature in the room of 74.9F. Then, when it is zero outside, the inside surface temperatures of the glass and outside wall will be, respectively,

$$S_g = 74.9 - \frac{1.1}{1.75}(74.9 - 0) = 27.9F$$

$$S_w = 74.9 - \frac{.32}{1.75}(74.9 - 0) = 61.2F$$

Then the weighted average of all room enclosing surface temperatures, if inside walls, floor, and ceiling are at room air temperature, will be

$$t_r = \frac{(150 \times 61.2) + (50 \times 27.9) + (400 \times 74.9)}{600} = 67.5F$$

and the operative temperature will be

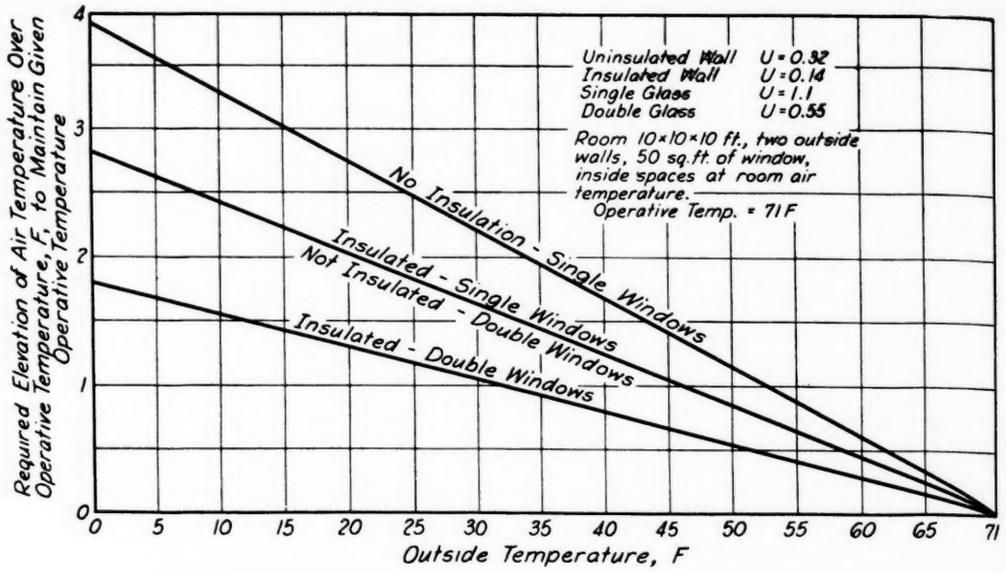


Fig. 3. The effect of insulation and double glazing on air temperatures to maintain a given operative temperature for the example cited.

$$t_o = (.533 \times 67.5) + (.467 \times 74.9) = 71F$$

In the foregoing example it was necessary to use an air temperature of 74.9F to produce an operative temperature of 71F when it is 0F outside, due to the cold walls and glass. If this room had been insulated to a point where the U of the outside wall was 0.14 (instead of .32), using the same method as before it can be shown that the t_o of 71F can be met with an air temperature of 73.8F. The wall surface temperature would be 67.9F instead of 61.2F.

In the case of the uninsulated wall ($U = .32$) it was necessary (at 0F outside) to maintain an air temperature of 74.9F to satisfy the occupants who desire an operative temperature of 71F—an elevation of 3.9F. With an insulated ($U = 0.14$) wall, a 73.8F air temperature produces the same result, an elevation of only 2.8F.

Obviously, insulating the wall is only one way of reducing this uneconomical increase in air temperature. Double windows can be employed. In the case of the example given, it is a coincidence that we can obtain exactly the same operative temperature with the same air temperature (73.8F) using double windows ($U = 0.55$) and an uninsulated ($U = 0.32$) wall as we did with the single window, insulated wall. However, if we insulate *both* the wall and the glass (by double windows), and asume an air temperature of 72.8F, we have

$$S_g = 72.8 - \frac{0.55}{1.75}(72.8 - 0) = 50.0F$$

$$S_w = 72.8 - \frac{1.1}{1.75}(72.8 - 0) = 67.0F$$

and

$$t_r = \frac{(50 \times 50.0) + (150 \times 67.0) + (400 \times 72.8)}{600} = 69.4F$$

and

$$t_o = (.533 \times 69.4) + (.467 \times 72.8) = 71.0$$

and the required elevation of air temperature has been reduced to $(72.8 - 71.0) = 1.8F$, at 0F outside.

The air temperature elevation above the operative temperature reduces as the outside temperature rises, so that, in the case of this example, at an outside temperature of 43.6F (the average outside temperature during a normal heating season in New York City), with insulated wall and double window, a t_o of 71.0 is obtained by an air temperature of 71.8F, a required elevation of only 0.8F.

Fig. 3 shows graphically the required elevation of air temperature necessary to produce the t_o of 71F *for the example given.* The ratio of glass area to outside wall area in the example, as well as other conditions, accidentally cause the figures for the insulation—single-glass condition and the double-glass—no-insulation condition to fall on the same curve in this example. It can be seen in Fig. 3 that insulation and/or double windows effect not only the saving in cost of maintaining a given ambient air temperature but also the saving or "comfort bonus" of lower ambient temperature requirements represented by the space between upper and lower curves.

The following conclusions can be drawn:

1. In any room having a surface exposed to outside air temperature, the inside air temperature must be increased as the outside air temperature drops to maintain a given operative temperature;

2. The amount of this required elevation in air temperature increases as the ratio of outside surface to total enclosing surface increases.

3. The amount of this required elevation in air temperature increases as the coefficient of heat transmission increases, or conversely, decreases as the wall or glass is insulated.

4. The greater the ratio of outside wall to total outside surface, the more the required elevation can be reduced by wall insulation;

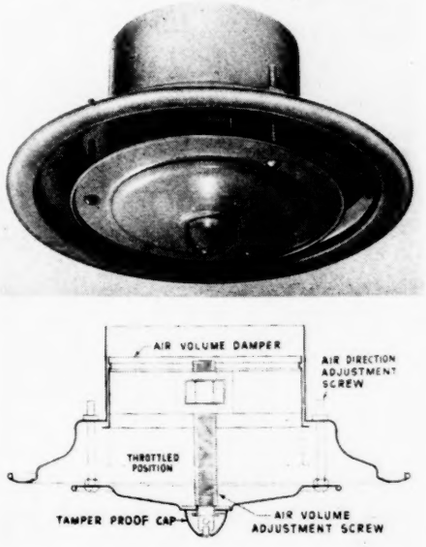
5. The greater the ratio of glass to total outside surface, the more the required elevation can be reduced by double windows.

It follows that if the outside wall surfaces are insulated to some undetermined point, the required elevation in air temperature will be so small as to be unnoticed by the occupant, so that the sensation of cold experienced when the outside temperature drops sharply would be completely eliminated.

NEWS OF EQUIPMENT AND MATERIALS

Air Diffuser

NAME—Kno-Draft air diffuser.
PURPOSE—Air distribution.
FEATURES—A tamperproof cap has been added to the base of the damper control screw, and held by a Phillips screw to prevent tampering with the air adjustments. Volume control damper may now be set for the required amount of air without the ordinary chance that someone might change the adjustment. Lower cone may be raised or lowered to vary the



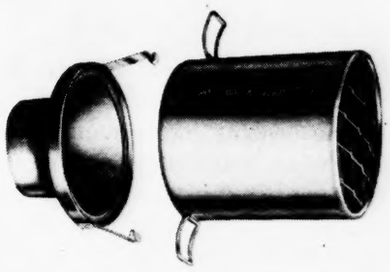
angle of air discharge. It makes it possible to diffuse chilled air parallel to the ceiling during the cooling season and heated air downward during the heating period.
MADE BY—*W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y.*.....1

Valves

NAME—Weldvalves.
PURPOSE—For high pressures.
FEATURES—Steel valves are made in gate, globe and angle designs and in 600 through 2,500 lb standards. Makers claim that this valve affects savings of from 30 to 60% in weight and that they give accurate alignment, are more compact and have fewer parts.
MADE BY — *Manning, Maxwell & Moore, Watertown, Mass.*.....2

Air Filters

NAME—EC2 and EC4 air filters.
PURPOSE—To filter industrial air.
FEATURES — Two 7 in. types are being produced with capacities of 90 to 165 cfm. Sizes up to 14 in. diameter and with capacities up to 730 cfm are scheduled for later manufacture. Filter element is enclosed in a cylindrical steel housing, and a cast iron adapter base. Filter element consists of two or more 2 in. packs of spirally wound herringbone crimped screens that are permanent and easily cleaned. Adapter has a standard 3 in. pipe thread. Filter unit is locked into the adapter by means of heavy spring clips. They are cleaned by



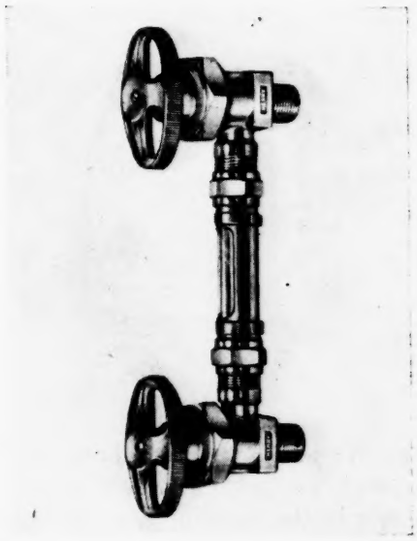
high pressure streams or by agitating in a tank with a good commercial cleaning fluid.
MADE BY—*Farr Co., 2615 Southwest Dr., Los Angeles 43, Calif.*
.....3

Aluminum Calculator

NAME—Reynolds aluminum metals weight calculator.
PURPOSE — For calculating weight of various sizes of sheet, wire, rod and bar pieces.
FEATURES—Pocket size slide rule has scale on two sides. One side is for determining the weight of sheet and plate, wire, rod and bar, and the other side of the rule is used for determining the weight of small round wire, tubing and plate circles. Rule can also be used for other metals besides aluminum.
MADE BY — *Reynolds Metals Co., Aluminum Division, Louisville, Ky.*
.....4

Gauge Glass Set

NAME—Henry gauge glass set.
PURPOSE — Liquid level indication.
FEATURES—Valve stem packing is eliminated by packless valve construction. If through accident the glass tubing should break, a safety ball check in each valve operates to



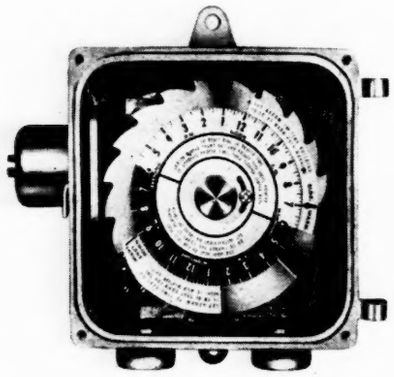
keep the liquid from escaping and to maintain pressure. A slotted metal guard protects the glass tubing and yet provides a clear view of the liquid column. Horizontal valve outlets are 15 in. center to center. Standard tubing length is 12 in., and the exposed length, 10 in. Valve and fittings are of forged brass.
MADE BY—*Henry Valve Co., 3260 W. Grand Ave., Chicago 51, Ill.*.....5

Flue Gas Calculator

NAME—Flue gas heat loss calculator.
PURPOSE—Simplification of flue gas calculations.
FEATURES—Calculator or slide rule is designed to be used after the percent of CO_2 in the flue gas, the temperature of the flue gas, and the room temperature have been determined. Figures show the per cent of total heat loss in the flue gas. Data can be converted into fuel loss. Calculator distributed without cost.
MADE BY—*The Hays Corp., Michigan City, Ind.*.....6

Temperature Control

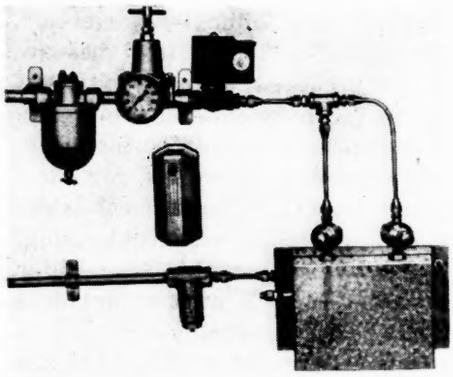
NAME — Weather-Man automatic temperature control.
PURPOSE—To provide proper heating temperature control for day and night service.
FEATURES — Instrument is claimed to combine the features of the inside room thermostat, the day-night



switch and the 65F high limit thermostat. The time at which heating starts in the morning and the time at which it shuts down at night is automatically changed as the weather becomes warmer or cooler. Heating stops when outdoor temperature reaches 65F. Since it combines the function of several instruments, the wiring to the control has been simplified. Unit may be used to operate a gas or oil burner, stoker, circulating pump, fan, motor valve or zone valve, and with all types of heating systems.
MADE BY—*Weather Controls Division, Automatic Devices Co., 53 W. Jackson Blvd., Chicago 4, Ill.*.....7

Humidifying Unit

NAME — Industrial humidifying unit.
PURPOSE—Packaged unit with all equipment to produce a finely atomized humidifying spray.
FEATURES—Unit comes in two or four-nozzle systems with humidistat control. Nozzles can be set at various angles to increase efficiency of moisture distribution. They use compressed air which mixes with the liquid to produce a fine spray. All nozzle parts, except screens, are made of white plated brass. The screens are monel metal.



MADE BY—*Spraying Systems Co., 4031 W. Lake St., Chicago 24, Ill.* 8

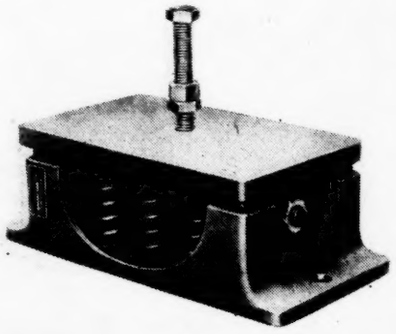
Portable Heater

NAME—Janitrol portable heater.
PURPOSE—Originally designed for airplane heating, now among other uses, being produced for contractors to speed construction work.
FEATURES — Portable unit is designed to burn gasoline, kerosene or light fuel oil. Liquid fuel is introduced into the cylindrical combustion chamber through a spray nozzle. A fan, driven either by a gasoline engine or an electric motor, supplies the heater with combustion and ventilating air. Makers claim that unit has been effective in removing frost from brick, thawing sand and gravel, speeding the drying of plaster walls, and for preheating machinery.

MADE BY — *Surface Combustion Corp., Toledo, Ohio.* 9

Vibration Control

NAME — Type LK Korfund vibroisolator.
PURPOSE — Vibration isolation for equipment.
FEATURES — Equipment to be isolated is fastened to the top plate by a bolt which passes through the machine base. This bolt bears on the spring compression plate and thus transfers the load to the steel springs. The bolt also provides a means for critical adjustment. Holes in the base plate permit bolting the unit to the sub-structure. Resilient inserts control lateral vibration and these inserts can be adjusted to provide varying degrees of damping. Two horizontal bolts provide the necessary compression.



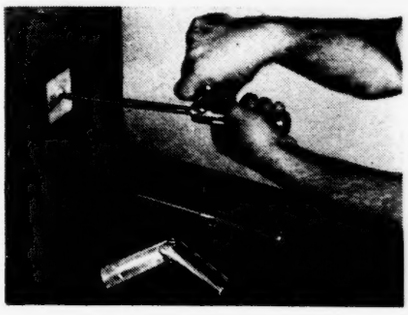
LITERATURE AVAILABLE — Catalog LK 550.
MADE BY—*The Korfund Co., Inc., 48-15 32nd Pl., Long Island City 1, N. Y.* 10

Tube Expander

NAME—Model 16 Dudgeon tube expander.
PURPOSE—For general boiler work.
FEATURES—Frame holding the rolls is one piece heat treated steel while the mandrel and rolls are hardened tool steel. Rolls are reversible for double length of service, and are set at an angle with the mandrel for self-feed. Reversing the mandrel releases the expander from the tube. Expander is readily dismantled and new rolls can be inserted. Tool is furnished for hand or combination hand and power use.
MADE BY—*Richard Dudgeon, Inc., 24 Columbia St., New York 2, N. Y.* 11

Screw Driver

NAME—Tuffy triple purpose screw driver.
PURPOSE—General screw driver use.
FEATURES—Tool has an aluminum "power arm" which when not in use, folds back against the handle. In use with the arm swung out, it is possible to apply body pressure to the tool blade and facilitate the removal of screws without cutting the head or slot. When inserting screws, the side arm makes possible an extra quarter turn to hold the



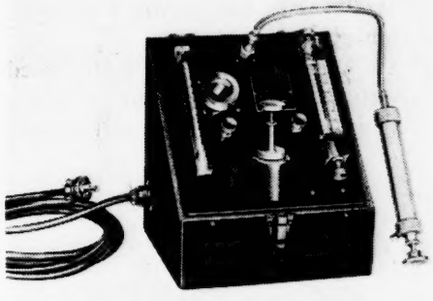
screws firmly in place. Blade is drop forged steel and is plated to retard rust.
SIZES AND CAPACITIES—5 x ¼ in., 6 x 5/16 in., 8 x ⅜ in. blades.
MADE BY — *Swallow Airplane Co., Wichita, Kans.*.....12

CCA Insulation

NAME—CCA insulation.
PURPOSE — For use where light weight is required and high insulating efficiency.
FEATURES—Material is lighter than cork and has good compressive strength when bonded between two panels of metal, wood or another plastic. Thin sheets of metal wood or plastic, each in itself unable to stand up without bending, are effectively supported by this central core of plastic. Material is of uniform density, is not brittle and makers claim it will not crack or break down under vibration. It is now made in strips 3½ in. wide, ⅝ in. thick and of any desired length. Thicker and wider strips will be made soon. Plastic may be tooled or shaped with any woodworking machinery and is made in four ranges of density: 4 to 5, 6 to 7, 7 to 8 and 8 to 9 lb per cu ft. Company expects to get on full scale production of this material about August 1.
MADE BY — *E. I. Du Pont De Nemours & Co., Wilmington 98, Delaware.*.....13

Dew Point Indicator

NAME—Alnor dew point indicator.
PURPOSE—Instrument for easy determination of dew point, relative humidity, grains of moisture per pound and latent heat of any known corrosive gas.
FEATURES—Air sample is drawn into the instrument and is held in the observation chamber at a temperature above atmosphere by means of a small hand pump. A pressure ratio gage indicates the relation between gas sample pressure and atmospheric pressure.



Temperature is indicated by a mercury thermometer. Indicator is available in two ranges from —20F to room temperature and for dew points from —100 to 0F.
OPERATION — Depressing operating valve produces a visible condensation suspended in the gas in the lighted observation chamber. A lens system provides a beam of light to make this fog visible. Temperature of the dew point of the sample is read from a chart based upon initial temperature and pressure ratio. Relative humidity, latent heat, and grains moisture per pound are obtained from reference charts once the dew point is known.
MADE BY—*Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.*.....14

Swivel Pipe Coupling

NAME—All-Flex ball bearing swivel pipe coupling.
PURPOSE — For fluids under pressure.
FEATURES—Multiple synthetic packings and metallic seals are claimed to provide protection against leakage at high and low pressures. Metal backed packings and a double row of ball bearings are designed to permit ease of rotation. There is but a small area of contact between the male swivel element and the packing. Servicing is said to be relatively simple.
SIZES AND CAPACITIES — Available

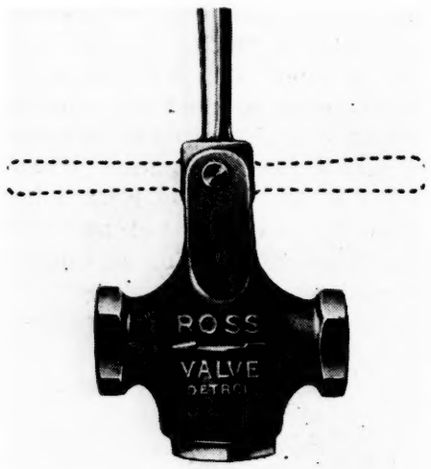
in sizes from ⅛ in. to 1 in. nominal tube size with various connections.
MADE BY—*Snyder Sales Corp., 5225 Wilshire Blvd., Los Angeles 36, Cal.*.....15

Fire Control Nozzle

NAME—Aquatomic fog nozzle.
PURPOSE — Production of fog for use with fixed fire control systems.
FEATURES—Water is forced through three spiral passages and a clear central passage in the head of the nozzle to form fog for fighting flammable liquid fires. Fog formed has a snuffing effect on petroleum industry fires. The nozzle can be used in systems controlled manually or automatically, and is best adapted for protecting processing and storage tanks in the chemical, electrical and petroleum industries.
MADE BY — *Blaw-Knox Sprinkler Division, Pittsburgh, Pa.*.....16

Shut-Off Valve

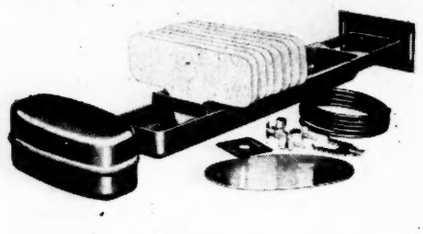
NAME—Ross shut-off valve.
PURPOSE—For use in air lines and for lines carrying gas and low pressure liquids.



FEATURES—Makers claim that this valve has full flow, that a flip of the valve lever quickly opens or closes the valve, that it is self-locking in both the closed and open positions, and that it provides visual indication as to whether the lever is in an open or closed position.
SIZES AND CAPACITIES—At present four sizes are available: ¼, ⅜, ½ and ¾ in.
MADE BY — *Ross Operating Valve Co., Detroit 10, Mich.* 17

Humidifier

NAME—Viking model 1100.
PURPOSE—For humidifying air in winter air conditioning systems and for gravity heating systems converted to forced air.



FEATURES — A narrow evaporator pan made of copper goes inside of the bonnet or plenum, while the water supply is maintained at a constant level by the float tank which is mounted outside of the furnace. The outside float tank is also made of copper. Water level is maintained automatically by the Viking top seat float valve in the float tank. High rates of evaporation are claimed because of the use of eight glass mat evaporators which are held by a rack vertically in the pan. Water is drawn up on the glass by capillary action. Humidifier comes complete in a package with all necessary fittings for either a straight side plenum or the sloping bonnet of a gravity furnace.
MADE BY — *Viking Air Conditioning Corp., 5600 Walworth Ave., Cleveland 2, Ohio.* 18

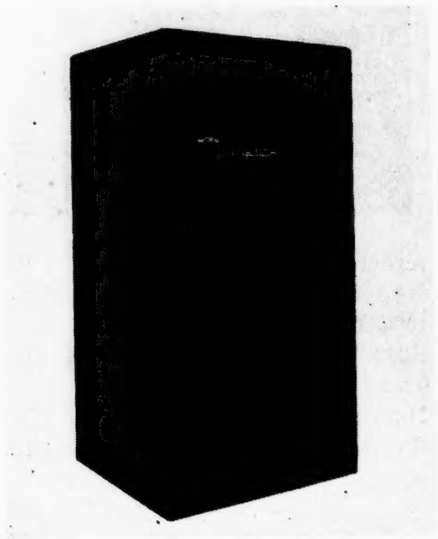
Steel Furnace

NAME—Mor-Sun pressed steel furnace.
PURPOSE—For forced warm air conditioning.
FEATURES — Unit is die-pressed throughout. Heat exchanger, which is of 12-gauge steel, has eliminated

baffles, radiators, dirt and condensation traps, gaskets and reverse flue travels. Furnace will be available for gas and oil in a bonnet output range of 60,000 to 200,000 Btu. Furnace is completely assembled at the factory and is marketed as a package unit.
MADE BY—*Morrison Steel Products, Inc., Buffalo 7, N. Y.*.....19

Air Cleaner

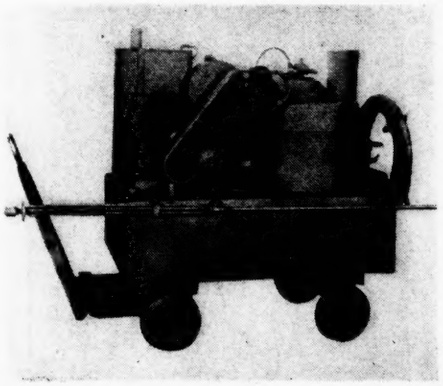
NAME—Raytheon dust precipitator.
PURPOSE — Removal of dust and other foreign matter in air by electrostatic means.
FEATURES—Precipitator consists of three principal parts—dust collector cell, ionizer unit and the power supply which converts 115 volts a-c into high voltage d-c. About 12,000 volts are supplies to the ionizer and 6,000 volts to the collector. The package unit comprises the three parts mentioned, a ¼ hp motor blower, and is capable of handling 1,200 cfm. Makers say unit can



remove 90% of all dust particles above 1/10 of a micron in the air passing through the unit. Cabinet measures 26x27x54 in.
OPERATION—Ionizers are energized by the power pack with high voltage d-c creating a strong electrostatic field. As air passes through this field, every particle of matter receives a positive charge. Within the area of the cell are parallel plates, termed collectors, separated by an air gap, and alternately charged with high voltage d-c. Positively charged dust particles are attracted to the negatively charged plates and are held there until the plates are washed. On some units, washing equipment is self-contained; others have removable collector plates for cleaning.
MADE BY — *Raytheon Mfg. Co., Waltham 54, Mass.*.....20

Steam Generator

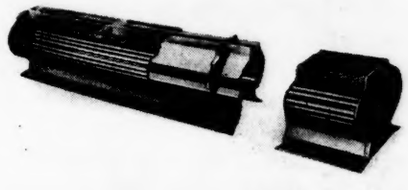
NAME—Oakite-vapor cleaning unit.
PURPOSE—Generation of steam under pressure.
FEATURES — Unit is oil fired, en-



closed coil type steam generator. Burns No. 1, 2, or 3 fuel oil, kerosene or gasoline. Generator can be mounted on a trailer chassis with pneumatic tires or on rubber tired shop wheels. It has a manual fuel metering valve or throttle and a number of automatic controls to prevent burning out of the coils and the building up of excessive steam pressures. Makers claim that starting from cold, 100 lb steam pressure can be produced in one minute or 200 lb in two minutes. While generator was designed primarily for use as a vapor cleaning unit with cleaning compounds, it has possibilities for straight steam generation.
MADE BY — *Oakite Products, Inc., 22 Thames St., New York 6, N. Y.* 21

Attic Ventilator

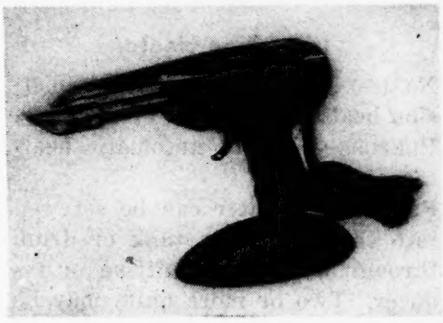
NAME—Klauer Ridgolator.
PURPOSE—Attic ventilation.
FEATURES—Unit fits any type roof



and is designed to follow the natural laws of air flow. During winter months high humidity air from the attic is released through the unit. Device is installed for the full length of the roof and provides more even distribution of air flow. The ventilator is effectively screened and is proof against the entrance of rain water. Longitudinal and cross baffles are said to assure efficiency regardless of the direction of the wind.
SIZES AND CAPACITY—Supplied in 6-, 9-, and 12-in. sizes and also in larger sizes up to 72 in. for industrial requirements.
MADE BY — *Klauer Manufacturing Co., Dubuque, Iowa.* 22

Soldering Iron

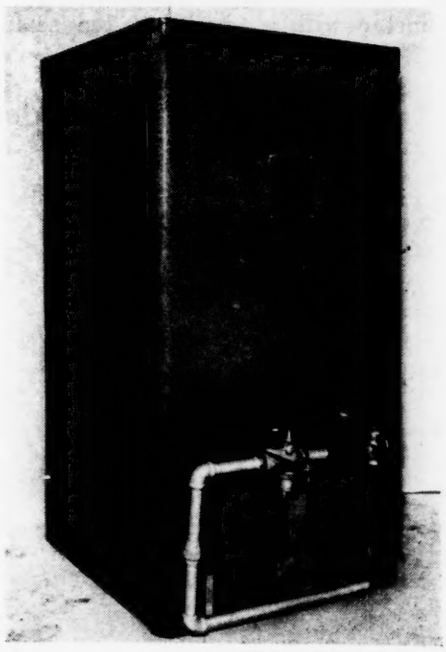
NAME—Eject-O-Matic.
PURPOSE—General soldering use.
FEATURES — Iron is electrically heated and is trigger operated to eject a measured amount of solder from a reel concealed in the handle. A retracting feature prevents the melting of excess solder on the heating tip. Amount of solder deposited on the heating tip is regulated by a micrometer adjusting



wheel accessible to the operator's thumb. A tube extending from the handle contains the heating element. A replaceable tip is grooved to guide the molten solder to the exact point of application. While the tip is designed for fast heating, excess heat is dissipated before it can reach the handle by 9 graduated cooling vanes located on the tube near the handle. A special stand provides a firm foundation for fine work.
MADE BY—*Multi-Products Tool Co., 123 Sussex Ave., Newark, N. J.* 23

Gas Furnace

NAME — Model 45 series Ryniker gas furnace.
PURPOSE—Space heating.
FEATURES — Unit, which measures 29 x 29 x 54 in. high, has an input of 95,000 Btu per hour and an output of 71,250 Btu per hour. Now made in a 95,000 and a 135,000 Btu size. It has a safety shut-off on the



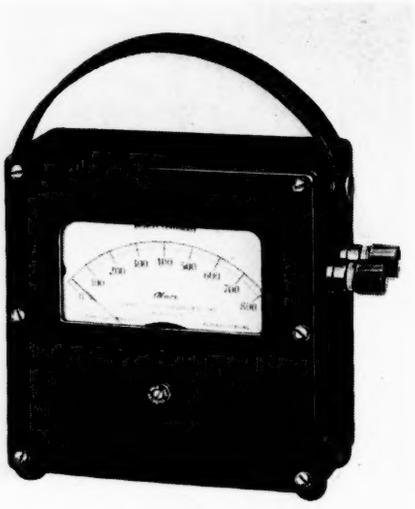
pilot control. Unit is also produced for propane and butane gas.
MADE BY—*Ryniker Steel Products Co., Billings, Mont.* 24

Protective Coating

NAME—Cotoid.
PURPOSE — Paint coating resistant to acids, alkalies, chlorides, oils, gasoline and alcohol solutions.
FEATURES—Application results in a finish which the makers claim is tough, hard, elastic, and after drying is odorless. Uses claimed are the inside and outside painting of concrete, steel or wooden tanks for corrosive solutions, brines and alkalies. Paint will withstand air or vapor temperatures of 220F and a maximum submerged temperature of nearly 150F.
SIZES AND CAPACITIES—Comes in 1, 5, and 10 gal cans and in 55 gal drums.
MADE BY—*The Lithgow Corp., 333 W. 40th Pl., Chicago 9, Ill.* 25

Pyrometer

NAME — Alnor type 1500 portable pyrometer.
PURPOSE — For general pyrometer use in laboratory and industry.
FEATURES—Instrument is mounted in a magnetically shielded metal case so that pyrometer can be used on steel top table or near other magnetic instruments. Type 1500 is available as a single circuit pyrometer with a choice of ten scale



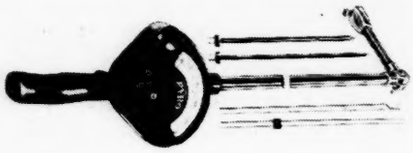
ranges, 0-400 to 0-3000F, and as a double or triple range instrument built to order with scales as specified. Centigrade scales furnished.
LITERATURE AVAILABLE — Bulletin No. 3879.
MADE BY—*Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.* 26

Welding Electrodes

NAME—Murex electrodes.
PURPOSE—High tensile arc welding.
FEATURES—Line consists of 8 electrodes, four for use with alternating current or on direct current with straight polarity, and four for direct current with reverse polarity. Electrodes were developed to meet the needs of fabricators of power plant piping. They depend for their mechanical properties on graduated alloying contents of chromium and molybdenum.
MADE BY—*Metal & Thermit Corp., 120 Broadway, New York 5, N. Y.* 27

Immersion Pyrometer

NAME—Pyro immersion pyrometer.
PURPOSE — Temperature measurement.
FEATURES—Instrument has a 4 in. direct reading scale calibrated from 0 to 1500F or 0-2500F or equivalent values in Centigrade. A swivel from the connector block permits the use of instrument at any angle. Swivel is equipped with two notches to prevent the instrument from becoming loose during its operation. Unit can be used with bare metal or protected type thermocouples and both styles are interchangeable. Unit



has several types of interchangeable thermocouples.
LITERATURE—Catalog No. 150.
MADE BY — *The Pyrometer Instrument Co., 103 Lafayette St., New York 13, N. Y.* 28

Immersion Heater

NAME—Automatic electric immersion heater.
PURPOSE—For the automatic heating of liquids.
FEATURES—Heater can be screwed into the walls of a tank or drum through a 1 in. pipe fitting or reducer. Two or more units may be installed for one application to provide step temperature control. By turning an indicator screw, heater can be set from room temperature to 350F. A built in safety control limits the temperature rise and protects against overheating and burning out should the liquid level fail and uncover the heating element. Units are available with copper sheaths for heating water or with steel sheaths for heating light oils in ratings of 250, 500, 750 and 1,000 watts.
MADE BY — *American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.* 29

Oxygen Recorder

NAME—Bailey oxygen recorder.
PURPOSE—For automatically indicating the oxygen content of gaseous mixtures.

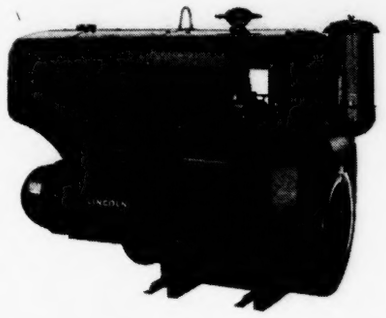
FEATURES—Instrument provides an instant graphic analysis and is said to be responsive to changes of 0.05% oxygen and to be accurate to within 0.25%.
OPERATION — A continuous gas sample is mixed with a vaporized liquid fuel and is burned on a catalyst filament which reaches a temperature proportional to the oxygen content. The filament resistance is a function of temperature. A simple resistance bridge is connected to an electronic recorder.
MADE BY—*Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.* 30

Bronze Welding Rod

NAME—Oxweld No. 25M.
PURPOSE — General uses for flux coated welding rod.
FEATURES—When rod is made, it is precoated with flux in proper proportion to its size. Coating adheres firmly to the rod, and the rod can be heated or bent without destroying the coating. Makers claim the flux melts into the weld in the right quantities, leaves no wasteful residue on the face of the weld, and that the coating does not burn off ahead of the rod.
MADE BY—*The Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.* 31

Portable Welder

NAME—Shield-Arc Jr.
PURPOSE—General welding.
FEATURES — This 200 amp welder has a current range from 40 to 250 amp and can be used for the welding of light or heavy gauge metal. Output panel has provisions for three ranges of output current.



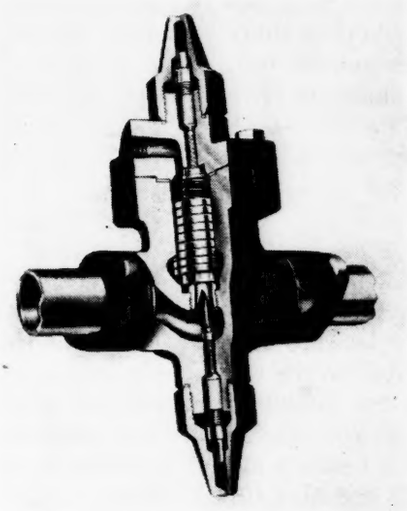
Generator controls are in an enclosed cabinet above the generator. Unit is powered by a Wisconsin air cooled 4-cylinder V-type engine. Shrouds around the engine fan and cylinders direct the cooling air. Engine speed, which determines the welding current, is from 1,500 rpm (16 hp) to a maximum of 2,100 rpm (22 hp). Welder has a 6 gal gasoline tank. Two transverse mounting rails are provided for bolting the welder to floor or platform, or on a trailer.
MADE BY—*The Lincoln Electric Co., Cleveland 1, Ohio.* **32**

Transfer Valve

NAME—Four-way transfer valve.
PURPOSE—For transferring liquids from more than one pipe line.
FEATURES — Single vane in four-way valve determines the direction of flow. Adjustable stop screws and indicator determine the vane position. Valve can be manually or automatically operated and is fabricated from all types of metals in sizes from 4 to 72 in. Makers claim that "A" metal used resists galling, wire drawing, and the wearing action of abrasive materials.
MADE BY — *R-S Products Corp., Wayne Junction, Philadelphia 44, Pa.* **33**

Pilot Operated Valve

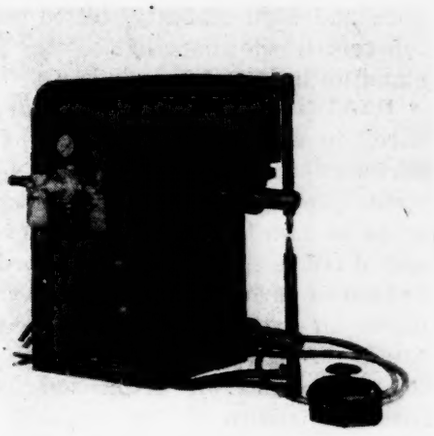
NAME—Phillips No. 701 pilot operated valve.
PURPOSE—Valve for controlling flow of refrigerant operated through an outside control.
FEATURES—Piston valve is actuated by controlling pressure in the power cylinder above the piston. Pilot valve can be a float valve, thermal expansion valve or magnetic solenoid between the evaporator and the power cylinder. Valve is opened by releasing the pressure from the power cylinder above the piston. High side pressure from the liquid line is used as the main closing force. A bleed port in the



piston permits continuous flow of liquid through the piston to the chamber of power cylinder above the piston. Two types are available —for ammonia and for Freon.
MADE BY — *H. A. Phillips & Co., 3255 W. Carroll Ave., Chicago 24, Ill.* **34**

Spot Welder

NAME — Universal USP-7½ spot welder.
PURPOSE—Bench type spot welder.
FEATURES—Unit includes a solenoid valve which controls the air cylinder. Adjustable pressure switch provides a wide range of uses for welding non-ferrous metals, wire, and two pieces of 16-gauge steel. Welder has a built-in NEMA 1A electronic timer but it can also be furnished with a NEMA 3B or 5B separate timer panel. The 7½ kva model is equipped with air filter, pressure gauge, and automatic lubricator. Unit has a water cooled transformer and electrodes. Welding cycle is started by an electric foot switch.
LITERATURE AVAILABLE.—Bulletin.
SIZES AND CAPACITIES. — The 7½ kva model is added to a line that



now includes a 1 kva and a 3 kva size.
MADE BY—*Davis & Murphy, Davis Bldg., 5252 Broadway, Chicago 40, Ill.* **35**

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

Fill in your name and address, detach and mail to
Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

Name.....
Title.....
Firm.....
Business Address.....
City and State..... 4/46

NEWS OF THE MONTH

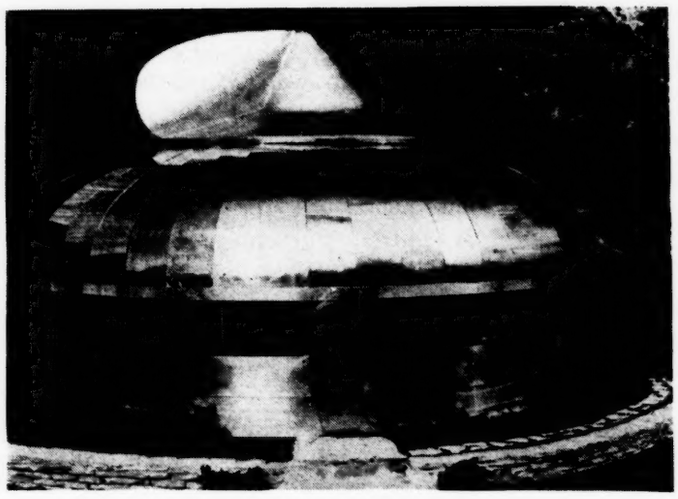
ROUND HOUSE

Fuller house to be mass produced by aircraft manufacturing facilities.

Unique answer to the housing shortage was the announcement in mid-March of production plans for the Fuller house. This house, resembling an aluminum and plastic hive, is a lineal descendant of the original dymaxion house designed by R. Buckminster Fuller twenty years ago which he then called the house of the future..

• **SUSPENDED.**—Structurally, the Fuller house utilizes newly developed tensile strengths of materials rather than the traditional compression strengths of ordinary building construction. This allows the hemispherical structure to be suspended from a central steel mast around which are grouped all the facilities for heating, ventilating, lighting, etc. The periphery is stabilized by anchoring to the ground. Hemispherical shape of the house gives the greatest cubic content per unit of exterior area, and circular floor plan similarly gives greatest area per unit of perimeter. Low air resistance and high stability, tested in wind tunnels, are inherent in the shape of the structure and allow it to stand up in hurricane winds.

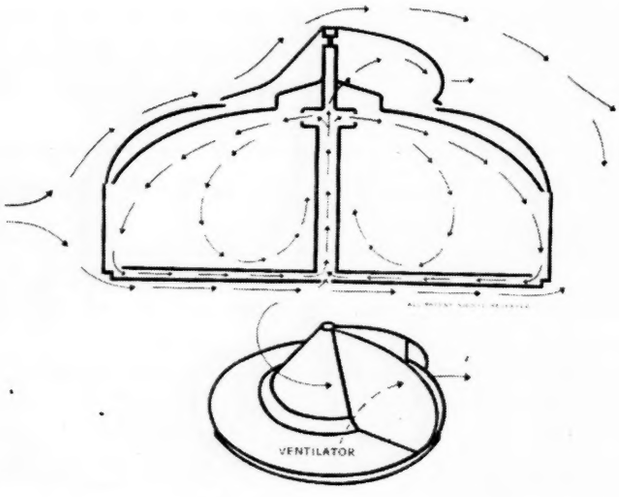
• **HEATING.**—Heat losses from the structure are reduced to a minimum not only by the hemispherical surface shape economy but also by the fact that exterior pressures are equalized and any leeward low pressure area is controlled by the ventilator on the top and directed upward and away from the building. Ventilator turns to head into the wind and can change inside air every six minutes if desired. Outside air enters through a duct system in the roof and beneath the floor. Interior convection currents follow the natural contours of the dome-like structure as they well up through the center and diffuse downward along the ceiling from air conditioning and heating facilities



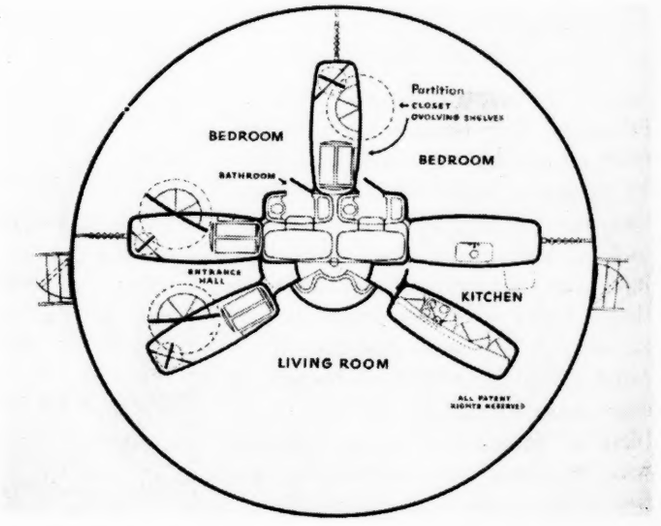
Model of Fuller house in landscaped setting.

using gas, oil, or electricity located in the central column. The Plexiglas window which surrounds the house consists of a double layer of plastic separated by ⅛ in. air space for thermal efficiency. The aluminum roof, unpainted, reflects the sun's heat in the summer, and triple-layer construction, including aluminum foil insulation, retains heat in the winter. Year-round air conditioning and heating is said to cost about ¼ of the cost of heating a conventional house of similar volume (12,000 cu ft).

• **FACILITIES.**—Price of the Fuller house ($6,500 delivered and erected) includes heating, ventilating and air conditioning equipment, bathroom fixtures and kitchen complete with sink, range, electric refrigerator, washing machine, clothes drier, dish washer and garbage disposal unit. The first models will be one-story, single-family dwellings, 36 ft in diameter, 22 ft high (including ventilator) and with a floor area of 1017 sq ft. Floor-to-ceiling height will be 16 ft. Floor plan of the house includes a living room with dining-room facilities, a kitchen, two bathrooms, two



Ventilator heads into wind and uses low pressure pocket to draw air through system. Heater is 2/3 way up mast. Main intake is under floor around mast at center.



Floor plan of the Fuller house shows hollow aluminum and plywood partitions which can be set at any desired angle from center and which contain closet facilities.

bedrooms and an entrance hall. Special closets and sets of drawers on endless chains are built into thick aluminum partitions. Inside surfaces are panels of aircraft plywood either painted or papered, as desired. Walls beneath the windows and inside doors are covered with a plastic fabric which has the appearance and feel of leather and is available in different colors. The floor is of impregnated plywood sections joined with aluminum strips and supported by aluminum beams. In place of the suspended floor shipped from the factory, the Fuller house can be erected over an insulated concrete base which is then covered with wood, linoleum or plastic. This type of floor will be optional for those who wish to save on house cost.

Parts of the house will be shipped from the factory in a single cylindrical steel container of 300 cu ft capacity, 16 ft long and 4½ ft in diameter. Kitchen equipment will be crated and shipped separately by the manufacturers. The complete house and container except for kitchen equipment weighs about 8000 lb.

• **PRODUCTION.**—Mass production of the Fuller house will be undertaken by Beech Aircraft Corp. in Wichita, Kans., about next January. The estimated capacity is 50 to 60 thousand houses a year. Sponsorship of the aircraft production tie-in originated with the International Association of Machinists, AFL, and the Fuller board of directors has AFL and CIO members.

Mr. Fuller, board chairman and chief engineer of Fuller Houses, Inc., and Herman Wolf, president, point out that the principles of special economy and performance-per-pound utilized in the design of the Fuller house required the availability of huge manufacturing facilities and fabricating techniques utilizing similar principles. This uniting of objectives has been found in the vast facilities of aircraft production plants where the materials used in the Fuller house and the principles of performance-per-pound are everyday commodities.

LOAD ESTIMATES

ACRMA publishes cooling load estimate forms for self-contained air conditioners.

The Air Conditioning and Refrigerating Machinery Association, Inc., Washington, trade association of manufacturers, has simplified the job of the sales engineer surveying stores, restaurants, or offices for self-contained air conditioners made by ACRMA members. The association has compiled a cooling load estimate form, copyrighted, listing all the factors to be considered in adequately air conditioning a space. It provides simple computations to indicate the number and capacity of air conditioners needed.

• **STORE COOLERS.**—Designed mainly as an aid in the sale of store coolers up to and including the 5-ton size, the form may be used in figuring jobs requiring larger self-contained air conditioners. General use of the form will minimize the number of under-capacity air conditioning installations.

• **HOW USED.**—The form, shown on the next page, is used as follows:

I. At the bottom of the form are spaces for inserting the summer outside design temperatures. Generally, the one design temperature will be adequate to cover the locality handled by any one salesman.

II. Insert the information called for in the six job identification lines at the top of the form.

III. The following numbered paragraphs refer to the item numbers of the form.

1. Insert the number of persons normally occupying the space after the air conditioning is installed. If it is a space which would be occupied by a large number of people for only a few minutes' duration and then a smaller number for the remaining time, use the largest number which would be present for approximately 15 minutes' duration.

2. Insert the maximum total square feet of window area on any one wall of the space exposed to direct sunshine. Refer to table A and select the proper factor which must be inserted in space indicated. If all of the windows are on the North wall or on a wall shaded completely from the sun by an adjacent building, no figure will appear here.

3. Insert the total number of watts in use, not including the watts consumed by appliances listed in table B. Lights in store show cases contribute heavily to the load and must not be neglected.

4. Use table B for calculating the heat load due to gas and electrical appliances and motor-driven apparatus. Insert the total in the space indicated in item 4.

5. After checking the extensions of the first 4 items, add them and carry this sub-total to a space at right.

6. Insert the total square feet of windows not included in item 2. In table C select the factor for these windows under the design outside dry bulb temperature previously established. Insert this factor in space indicated in item 6.

7. Three lines are provided in this item as it is quite possible that several wall constructions may be used on a particular space. In each case subtract the area of the windows from the total wall or partition area and insert the total net wall or partition areas. In table C select the proper wall or partition factor shown under the design temperature already established. Insert these factors on the proper lines at the spaces indicated in item 7.

8. Insert the total square feet of floor area. Refer to table C for the factor to be inserted in the space indicated.

9. Insert the total square feet of ceiling area. Refer to table C for the factor which fits the conditions of the building. Adjust this factor if ceiling is insulated and insert the factor or adjusted factor in space indicated.

10. Use table D for calculating the ventilation or infiltration cfm. The total number of occupants must equal those used in item 1. The infiltration does not include the cfm which would enter space if doors or

COOLING LOAD ESTIMATE

Recommended Practice for Members of Self-Contained Air Conditioner Section of

AIR CONDITIONING AND REFRIGERATING MACHINERY ASSOCIATION, INC.

This estimate is suitable for comfort air conditioning jobs not requiring specific conditions of temperature and humidity.

Copyright 1946

Customer ..... Buyer .....

Address ..... Space to be used for .....

Estimate by ..... Date ..... Approval ..... Date .....

1. People ..... (Number Sitting or Moving Slowly) ..... × 400 = ...
   ..... (Number Working, Dancing or Similar Activity) ..... × 660 = ...
2. Windows Exposed to Sun ..... (Total Sq. Ft.) ..... × ..... A = ...
   (Figure this item for the one sun exposure having largest window area)
3. Lights and Electrical Appliances ..... (Total Watts in Use) ..... × 3.4 = ...
   (Include in this item only those appliances not listed in Table B)
4. Other Heat Sources ..... B = ...
5. Sub-total—Sum of Items 1 thru 4 ..... = ⟶ .....
6. Windows Not Included in Item 2 ..... (Total Sq. Ft.) ..... × ..... C = ...
7. Walls and Partitions ..... Sq. Ft.—Windows ..... Sq. Ft. = ... × ..... C = ...
   ..... Sq. Ft.—Windows ..... Sq. Ft. = ... × ..... C = ...
   ..... Sq. Ft.—Windows ..... Sq. Ft. = ... × ..... C = ...
8. Floor ..... (Total Sq. Ft.) ..... × ..... C = ...
9. Ceiling ..... (Total Sq. Ft.) ..... × ..... C = ...
10. Ventilation or Infiltration ..... (Cu. Ft. per Min.) ..... D × ..... E = ...
11. Sub-total—Sum of Items 6 thru 10 ..... = ⟶ .....
12. Total Btu. per hour Cooling Load to be used for Selection of Unit—Sum of Items 5 and 11 ..... = ...

COOLING LOAD FACTORS

WINDOWS EXPOSED TO SUN—SOLAR RADIATION FACTORS FOR DIFFERENT ORIENTATIONS TO BE INSERTED AT A

Direction Windows Face	NE	E	SE	S	SW	W	NW
Clear Glass (Single or Double) No Protection	110	180	160	105	160	180	110
Shaded Completely by Awnings	30	50	45	30	45	50	30
Light Colored Inside Shades or Venetian Blinds	65	110	95	60	95	110	65
Glass Brick No Protection	44	72	64	42	64	72	44

OTHER HEAT SOURCES TO BE INSERTED AT B

Beauty Parlors	Number of Operators	× 2000 =	
Electric Motors	Total Name Plate HP	× 2800 =	
†Gas Burners	Number	× 6000 =	
†Glass Coffee Makers	Number	× 900 =	
†Coffee Urns—Gas or Electric	Coffee Capacity in Gallons	× 1400 =	
†Steam Tables—Electric	Sq. Ft. Area of Top	× 550 =	
†Steam Tables—Gas	Sq. Ft. Area of Top	× 1300 =	
Additional Heat Sources		BTU/Hr. =	

†Factors for appliances equipped with hood and positive exhaust should be reduced by 50%. Insert Total At B .....

WINDOWS, WALLS, FLOORS AND CEILING TRANSMISSION FACTORS FOR VARIOUS OUTSIDE DESIGN TEMPERATURES—INSERT AT C

Outside Dry Bulb °F	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Windows (No Sun)	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Walls—Heavy Masonry	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	6	7
Walls—Average Masonry	3	3	3	3	4	4	4	4	5	5	5	6	6	6	6	7	7	7	7
Walls—Insulated Masonry or Frame	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	5
Walls—Average Frame	2	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7
Partition—Inside, Single Thickness	5	5	6	7	8	8	8	9	10	10	11	11	12	12	13	13	14	14	15
Partition—Inside, Double Thickness	3	3	3	4	4	4	4	5	5	5	6	6	6	6	7	7	7	8	8
Partition—Display Window Back	11	12	13	13	14	14	15	15	16	17	17	17	18	19	19	19	20	21	21
Glass Brick (No Sun Exposure)	4	4	5	5	5	6	6	7	7	8	8	8	9	9	10	10	10	11	11
Floor	2	2	2	2	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5
Ceiling Under Unventilated Attic*	11	11	11	12	12	12	12	13	13	13	13	14	14	14	15	15	15	15	16
Ceiling Under Ventilated Attic*	7	7	8	8	9	9	10	10	10	11	11	12	12	13	13	14	14	14	15
Ceiling Under Flat Roof*	13	13	14	14	14	15	15	15	16	16	16	17	17	17	18	18	18	19	19
Ceiling Under Occupied Floor*	2	3	3	3	3	3	4	4	4	5	5	5	5	6	6	6	6	7	7

*Adjust factor selected from this table if Ceiling is insulated. Example: 4" Insulation—0.2 × Selected Factor = Adjusted Factor.

1" Insulation—0.4 × ..... = ..., 2" Insulation—0.3 × ..... = ..., 4" Insulation—0.2 × ..... = ...

VENTILATION OR INFILTRATION QUANTITY TO BE INSERTED AT D

Calculate Requirements for Both Ventilation and Infiltration, and Use Larger Quantity Cu. Ft. per Minute (CFM). Use No Less CFM than Required by Local Ordinance, and no less than amount drawn from space by exhaust fans if used.

VENTILATION REQUIREMENTS

SMOKING	No. OCCUPANTS		C.F.M.
None	.....	× 7½ =	.....
Light	.....	× 15 =	.....
Heavy	.....	× 40 =	.....

INFILTRATION

(H) = Room Height (L) = Length (W) = Width (G) = Wall Factor

Room with one outside wall (G) = 1

Two outside walls (G) = 1.5

Three or more outside walls (G) = 2

$$\text{C.F.M.} = \frac{(H) \times (L) \times (W) \times (G)}{60} = \text{.....}$$

VENTILATION OR INFILTRATION FACTOR FOR VARIOUS OUTSIDE DESIGN TEMPERATURES IN °F.W.B. TO BE INSERTED AT E

Outside Wet Bulb °F	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Factor	0	1	3	5	8	11	14	17	20	23	27	30	33	37	41	45	49

Cooling load estimate form, copyrighted by Air Conditioning and Refrigerating Machinery Association, Inc.

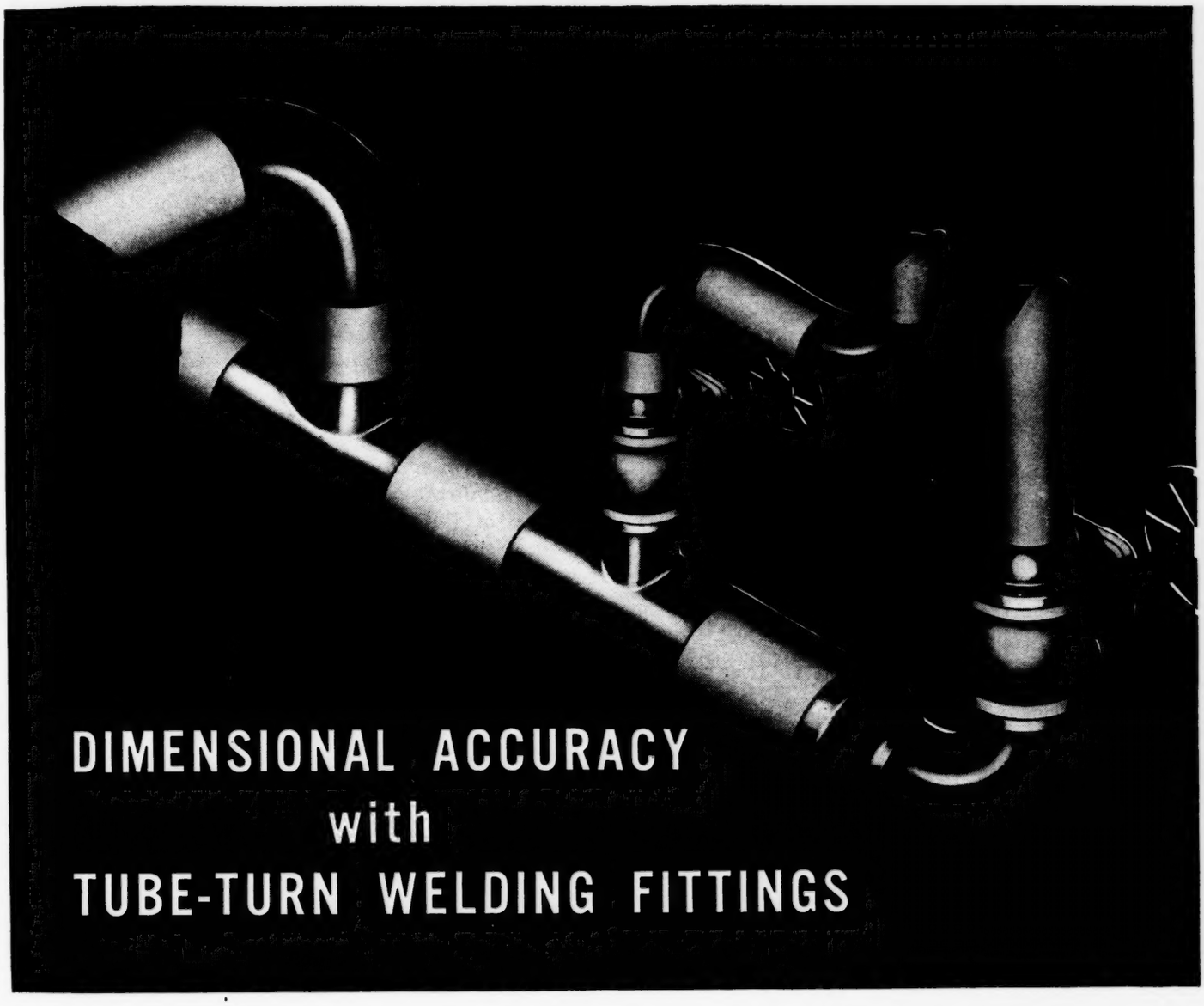
windows are permitted to remain open. Insert the cfm in space provided.

Refer to table E and select the factor shown under the design outside wet bulb temperature previously established. Insert this factor in space indicated.

11. After checking the extensions of items 6 through 10, add them and carry this sub-total to space at right.

12. Add sub-totals, items 5 and 11. This total is the Btu per hour cooling load. An air conditioner with capacity equal to or greater than this load must be selected to obtain comfort conditions within the space.

The forms, issued in pads, are for the use of member companies. The association will shortly publish an estimate form for room air conditioners.



DIMENSIONAL ACCURACY with TUBE-TURN WELDING FITTINGS

WHEN pipe and fittings agree in O.D., I.D. and wall thickness, alignment from the *outside* brings them into perfect alignment on the *inside* also. The dimensional accuracy of Tube-Turn welding fittings permits installing any pipe line according to design without making allowances for variations in individual fittings.

All Tube-Turn fittings of the same part number are identical in all dimensions. Quality-controlled Tube-Turn fittings incorporate uniform wall thickness, smooth inner wall and close-knit grain structure. This complete line is available in sizes ranging from one-half inch to 30 inches to meet all your fittings requirements.

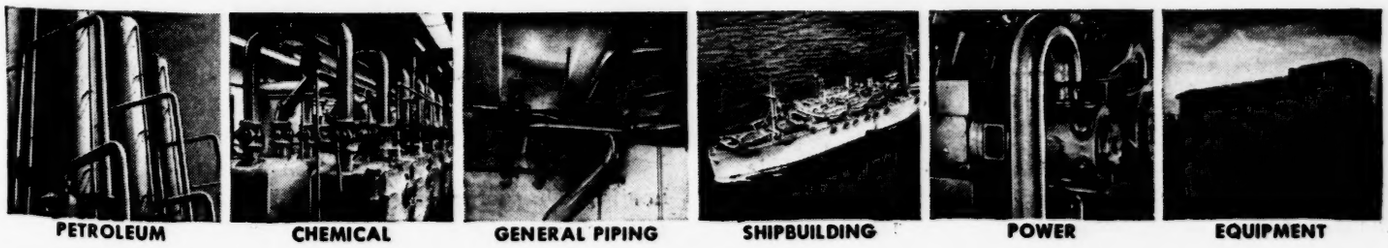
Consult your favorite piping authority and see your Tube Turns distributor. For more information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

• • •

Selected Tube Turns Distributors in every principal city are ready to serve you from their complete stocks.

TUBE TURNS (Inc.), Louisville 1, Kentucky. Branch Offices: New York, Washington, D. C., Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Houston, San Francisco, Seattle, Los Angeles.

TUBE-TURN TRADE MARK **tt** ***Welding Fittings and Flanges***



PETROLEUM | CHEMICAL | GENERAL PIPING | SHIPBUILDING | POWER | EQUIPMENT

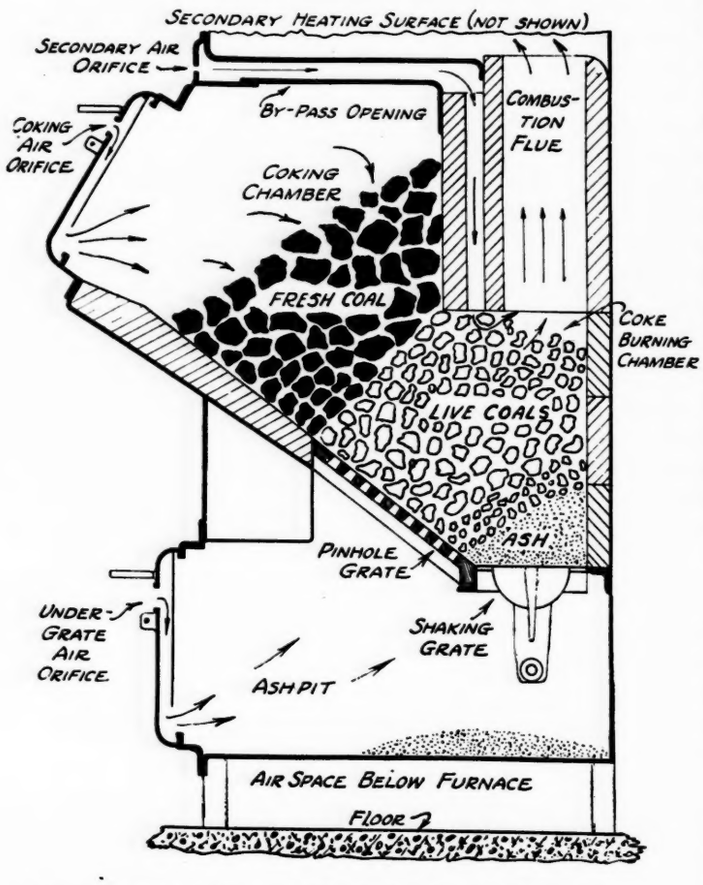
COAL BURNER

Smokeless hand-fired furnace on market in two years.

Coal burning, hand-fired furnaces and stoves that are virtually smokeless will be available in quantity for home heating in about two years, Professor Julian R. Fellows of the department of mechanical engineering, University of Illinois, predicted in a paper before The American Society of Mechanical Engineers at its annual Spring Meeting in Chattanooga.

• **TESTS.**—Tests described by Professor Fellows were made with the warm air furnace development known as the Illinois Smokeless Furnace. These tests were made in laboratories and in 100 field trial furnaces placed in actual homes. Although some mechanical difficulties are yet to be overcome, the tests reveal:

That the average householder can operate the smokeless furnace easily; that all bituminous coals can be burned successfully, though with the best results obtained from non-coking or slightly coking coal; that one or two firings will usually be sufficient in 24 hours; and that there will be a considerable saving in fuel. In Professor Fellows' own home, where one of the trial furnaces was installed, the coal saving will be about 30% this season.



Partial cross section of Illinois Smokeless Furnace.

Inventors have been working in this country on devices intended to burn bituminous coal smokelessly for about one hundred years, and more than 200 patents have been granted, the speaker stated. Yet no low cost hand-fired heaters are widely available today. In 1935 a project was begun at the University of Illinois. A research residence was sponsored by the National Warm Air Heating and Air Conditioning Association, where tests were made. Last year before the heating season started, 100 trial furnaces had been installed in various homes across the northern part of the country so that field experience could be had with a wide range of weather conditions, different types of coal and different operators.

Work on smokeless stoves also is under way at Battelle Memorial Institute in Columbus, Ohio, and a Cincinnati furnace company is developing a smokeless furnace. Professor John C. Miles, also of the University of Illinois, has developed a promising stove design soon to be home-tested.

• **DOWN-DRAFT.**—The Illinois Smokeless Furnace employs the down-draft coking principle. This is applicable to other types of hand-fired heating appliances, such as stoves, boilers and water heaters. The lower rear part of this furnace serves as the coke burning chamber, while the upper forward part is the coking chamber where fresh coal is placed.

In the operation of the furnace the fresh coal is slowly converted to coke by the heat liberated as a result of the combustion supported by the coking air, while the coke from the previous charge is slowly consumed by the undergrate air which supports conventional up-draft burning in the bed of live coals. As the gases are released from the coking coal, they are drawn under the baffle and mixed with secondary air which comes down to the mixing chamber through vertical passages in the baffle wall. The combustible mixture is ignited by the incandescent surface of the live coals under the baffle and burns in the combustion flues that are parallel to the rear wall of the furnace body. A pinhole grate is provided to assure an active bed of live coals regardless of the amount of ash that may accumulate over the shaking grate in mild weather operation. Well fitted doors and generally good construction are essential to reduce vagrant air leakage to a minimum.

• **FINDINGS.**—In the 100 trial furnace tests, these were some of the findings:

In the majority of cases the householders learned to operate the furnaces properly by reading the printed instructions. In some cases these had to be interpreted by the dealer, and in a few cases an engineer had to visit the installation to demonstrate the method of operation.

Although it was found easier to push back the coke in preparing the fuel bed for a fresh charge when burning a non-coking or slightly coking coal, all bituminous coals can be burned successfully by the average householder after he is familiar with the proper technique.

Householders were pleased in general with the fire-holding characteristics of the furnace and with the comparatively even house temperatures which could

EFFICIENT AIR FILTRATION *at lowest overall cost!*

MAINTENANCE COST ANALYSIS:
Air-Maze Permanent, Cleanable Filter
vs.
"Throw-Away" Type Filter
3100% OF ORIGINAL COST
COMPARATIVE ORIGINAL COST!
AND STILL AS GOOD AS NEW!
THROW-AWAY TYPE FILTER
AIR-MAZE KLEENFLO
KLEENFLOS HAVE PAID FOR THEMSELVES AT THIRD CLEANING
COMPARATIVE DOLLAR INVESTMENT IN CLEAN AIR
NUMBER OF CLEANINGS OR REPLACEMENTS

Air-Maze filtration is not expensive at all. In fact, on a maintenance basis alone (see chart), you're way ahead with an Air-Maze filter installation . . . it's so easily cleaned.

But that's not the whole cost story . . .

Air-Maze air filtration is economical because it offers the right filter for the right job. You have the advantage of getting a filter that is specially engineered for that particular job. This assures top filtering efficiency in every application.

This combination of economical maintenance *and* efficient filtration is what gives you lowest over-all cost when you specify Air-Maze. Write for latest literature and complete details.

AIR-MAZE CORPORATION • CLEVELAND 5, OHIO

Representatives in principal cities. In Canada: Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver, B. C.

AIR-MAZE KLEENFLO® PANEL
For air conditioning, ventilating.
Permanent, all-metal, cleanable.
®Trade Mark Registered.

be maintained. One firing in 24 hours in mild weather, two in normal winter weather, and three in zero weather were necessary.

• **ECONOMY.**—Regarding fuel consumption, Professor Fellows said:

"Only a few of the trial units have been used through one complete and continuous heating season. However, reports are encouraging. A user of one of the first trial units reports a fuel consumption of eight tons during the 1944-45 season compared with twelve tons the previous winter when using a conventional hand-fired furnace burning the same type of coal."

In conclusion the writer stated:

"Due to the extremely severe conditions imposed upon the baffle in the Illinois Smokeless Furnace and the use of some other parts not previously used in conventional furnaces, the manufacturers who are licensees of the University of Illinois Foundation feel that considerable service experience is necessary before it will be safe for them to manufacture the furnaces in large numbers. However, unless unforeseen problems arise in the meantime, there is every reason to expect that the unit along with companion stoves and competing stoves and furnaces will be available in sufficient numbers to fill the demand within the next two years."

BUILDING

Emphasis in nation's construction is directed to private housing.

With government restrictions on commercial construction and with price concessions along the line of residential requirements, U. S. construction is being channeled into the field of urgent housing requirements. Effects of many influences are reflected in F. W. Dodge Corp.'s report that residential building is mounting steadily in the 37 states east of the Rocky Mountains. February's residential volume was 14% higher than January's and 426% higher than in February, 1945.

• **LIMITATION.**—The Administration, moving to save scarce building materials for its veterans' housing program, curtailed new construction and repairs to existing structures. At the same time it renewed its appeal for legislation authorizing $600,000,000 in housing subsidies and curbing speculation on housing.

A long-awaited limitation order, VHP-1, issued by the Civilian Production Administration and the National Housing Agency, provides that no new construction or repairs, with certain exceptions, may be undertaken without specific authorization.

The order does not ban construction now being carried on, and for which the materials are already on the site. Nor does it prohibit "essential, non-deferable commercial, industrial and farm construction and unusual hardship civilian housing," for which specific authorization may be obtained.

• **PRICE.**—Efforts to study pricing problems and to grant conservative price relief designed to stimulate residential construction are reflected in the appointment of Gordon Rieley, vice president of Bryant Heater Co., as director of the newly established Building and Construction Price Division of the Office of Price Administration.

Gordon Rieley

The new division, which is being formed in part from the building materials division of OPA's industrial materials division, will work to expedite national housing programs by special attention to bottleneck supply situations.

Mr. Rieley, on leave of absence from Bryant, has been associated with that company for the past 12 years where he has specialized in market research.

• **MATERIALS.**—The struggle for materials is being carried on, according to the *New York Journal of Commerce*, between factions sponsoring the government's materials subsidy plan and manufacturers who are arguing for price increases on certain key building materials. Opponents of subsidies argued that the time required to place a subsidy plan into operation will only delay the end of the nation's critical housing shortage. The subsidy group believes that higher prices for materials will result in higher prices for new homes. They point out that most veterans cannot afford to purchase homes costing more than $6000.

EQUIPMENT

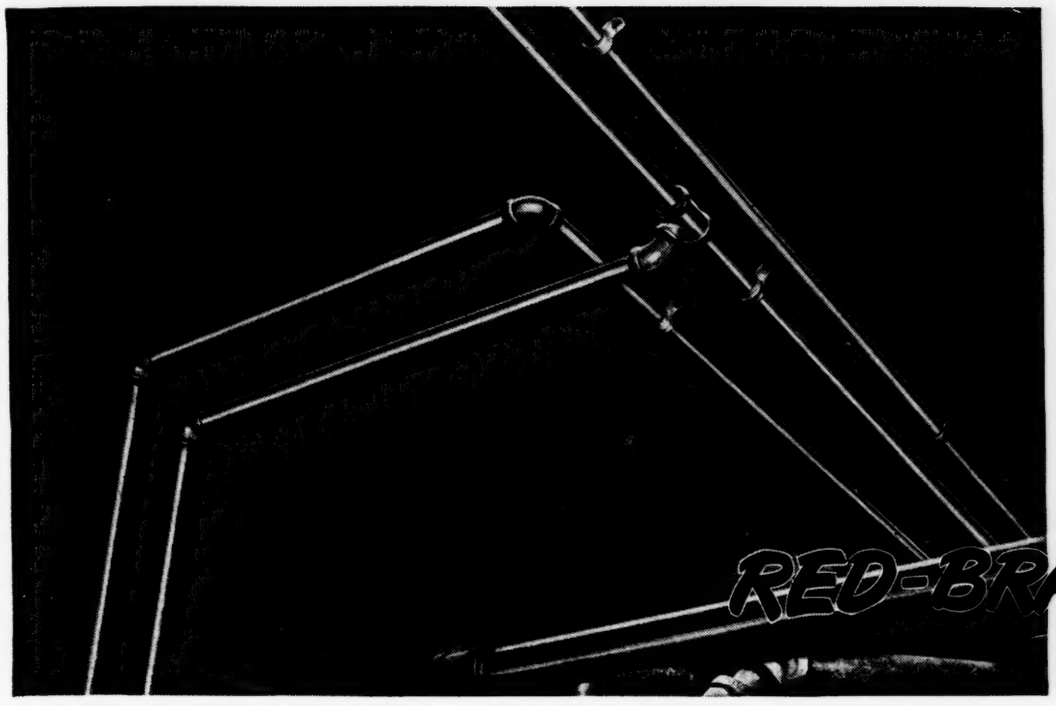
Mechanical equipment of buildings responds to research and promotion.

The mechanical equipment of buildings has come in for its share of public and private attention from both the development and production points of view.

• **RATION.**—Furnaces, pipe and fittings, and duct work, registers, and grilles have been declared critical products by OPA. The Steel Boiler Institute announces that it has received from the Office of Price Administration an increase of 14% in ceiling prices which were frozen October 1, 1941.

• **REFRIGERATION.**—At a series of meetings and conferences of manufacturers and wholesalers in the mechanical refrigeration and air conditioning industry, an expanded program to utilize the industry's maximum productive capacity was adopted at the spring conference of the Refrigeration Equipment Manufacturers Association and the Refrigeration Equipment Wholesalers Association held in Chicago.

• **STANDARDIZATION.**—Secretary of Commerce Henry Wallace proposes in a letter to Charles E. Wilson, president of General Electric Co., to reverse the wartime trend and return to private enterprise the important function of determining product standards.



. . . REVERE makes both

LOCAL water conditions or building codes occasionally dictate the choice between Red-Brass Pipe and Copper Water Tube . . . the engineer or contractor may also have a personal preference. In either case you can be sure of superior heating and water lines because Revere makes both. Both provide long, trouble-free service and are suitable for new building or modernization work.

Of particular interest in residential building is Revere Copper Water Tube (99.9% pure copper), which is seamless and is cold drawn with a gun-barrel finish inside. It is deoxidized, and is free from flaws and blemishes. Joints are made with either soldered or compression fittings.

Made for water supply, heating, air conditioning and other services in all types of buildings, this tube is stamped with the Revere name and the type at regular intervals. Look for these identification marks—they insure full wall thickness and the close gauge tolerances essential for tight sweated joints.

In making your plans you can specify or install such long-lived Revere materials as Copper Water Tube and Red-Brass Pipe; Sheet Copper for tanks, ducts, pans and trays; Sheet Herculoy for tanks; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call your Revere Distributor.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md ; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in principal cities, distributors everywhere

• • •

Listen to Exploring the Unknown *on the Mutual Network every Sunday evening, 9 to 9:30 p.m., EST*

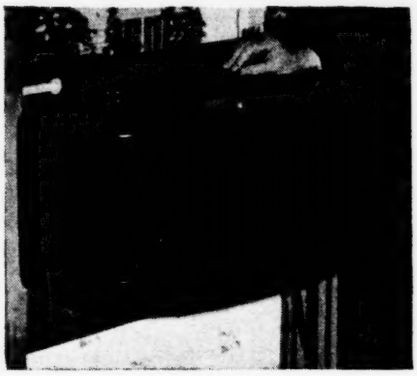
• **INTEGRATION.**—Facilities for production of the first industrial and commercial air conditioning systems to be wholly engineered and manufactured by one company were reported by Gwillym A. Price, president of the Westinghouse Electric Corp. To achieve these new systems the manufacturing and engineering facilities of the B. F. Sturtevant Co., purchased by Westinghouse in September, 1945, are being integrated with the facilities of the Westinghouse Air Conditioning Division, which has been transferred from Jersey City, N. J., to the Sturtevant main plant at Hyde Park, Boston. Executive vice-president of the new organization will be Ellis L. Spray. In addition to air conditioning in its complete sense, the new subsidiary will carry on the Sturtevant business in forced and induced draft blowers, etc. The 42 offices of the Sturtevant Company will be retained and coordinated with Westinghouse distribution points and personnel.

• **EDUCATION.**—Basic principles of home heating are being explained to thousands of prospective builders throughout the United States through an educational program instituted by Minneapolis-Honeywell Regulator Co. The program, endorsed by the United States Savings and Loan League, is being presented for audiences made up of members of home builders' organizations, civic clubs, home economics institutes and any other groups that are interested. It is built around a 35 mm sound slide film "Seven Keys to Comfort."

• **INSTRUMENTATION.**—Increasing recognition in the textile industry of the importance of instrumentation for recording, indicating and controlling processes and systems is reflected in the planned Southern Textile Conference Exhibit, Greenville, S. C., of the Brown Instrument Co., Philadelphia, and its parent company, Minneapolis-Honeywell Regulator Co.

Four instruments, chosen from a large group applicable to textile process and manufacturing, are being emphasized by the Brown company. These are: (1) The Moist-o-Graph which measures and controls yarn regain as warp passes to the slashed beam. The control permits production of a warp that contains the correct moisture content to meet specific weave room requirements. (2) The Time Pattern Transmitter and Receiver, a dual instrument set-up for size cooking and storage control systems. It has been developed to meet special requirements of those mills whose size cooking schedules demand maximum accuracy and whose patterns must be varied at frequent intervals. (3) The Brown Continuous Balance ElectroniK Indicating and Recording Potentiometer Controller which is being featured in connection with current and proposed continuous bleach systems. (4) The Thermometer-Hygrometer which measures and records on a single chart a continuous record of the factors of temperature and humidity. The Minneapolis-Honeywell Regulator Company will exhibit various devices for air-conditioning control. In addition, Brown has developed new systems covering controls for air dryers, festoon dryers, package and piece dye machines, nylon pre-boarders and others.

• **CONVENTION.**—Gathered for their first national dealer and distributor meeting since before the war, more than 300 dealers and distributors of Carrier products from all parts of the nation toured through a plant converted to high production capacity, saw new models of Carrier products, and heard plans.



Half-ton capacity room air conditioner.

Models on display at the meeting included food freezers of 15 and 30 cubic foot capacity; room air conditioners of one-half, three-quarter, and one and one-half ton capacity; a five-ton self-contained air conditioner; frozen food display case; condensing units and cold diffusers.

• **CONVERSION.**—Gadget engineers have discovered that push-pull remote control systems from discarded surplus bombing and transport planes may be employed to actuate deflecting fins on shop heating and cooling systems, to operate furnace controls, signal apparatus and transoms. They have made over hydraulic systems into supply tanks, valves, accumulators and other equipment, while ingenious portable work platforms have been made from the tubing.

One outcome of wartime industrial production facilities has been the efforts of outstanding wartime producers to get into the building business. Henry Kaiser, on a tour of inspection through the new Kaiser-Frazer plant showed the strength of a reinforced plastic board consisting of two sheets separated by an accordion pleated filler by jumping on it with his 225 pounds. He says that the material may be used as wall board or sheeting when Kaiser starts his Pacific Coast housing development.

Another colorful wartime producer, Andrew J. Higgins, is planning a novel system of concrete and steel construction which he thinks is ideal for fast, permanent housing. One of Higgins' talking points is his now thermo-con, a structural cement made from portland cement, water, and a special foaming agent. These are mixed in a special machine and poured like wet mortar. During the setting process the mortar fills with tiny air bubbles which more than double its volume and promote high insulating qualities.

• **HUMIDIFICATION.**—Experiments are now being conducted in a research laboratory of the General Electric Company in the measurement of minute degrees of humidity, under the direction of Dr. Katharine Blodgett and her associate, Vincent J. Schaefer. Dr. Blodgett says: "We are concerned primarily with the measuring of humidity which prevails at temperatures from zero to 70F where the moisture content of the air is so infinitesimally small that devices in current use are impractical."

Fiberglas Duct Insulation

Whether the requirement calls for the insulation of ducts or boilers—hot lines or cold—interior or exterior applications—your "best bet" is Fiberglas.

Because Fiberglas Insulation is made from fibers of glass, it has a combination of advantages found in no other single material. Of particular significance to anyone who buys, specifies or applies insulation are these ten facts:

1. **Fiberglas has high thermal insulating efficiency.**
2. **Fiberglas is inherently firesafe.**
3. **Fiberglas is light in weight.**
4. **Fiberglas has excellent sound-absorbing qualities.**
5. **Fiberglas has exceptionally low moisture pickup.**
6. **Fiberglas will not rot or decay.**
7. **Fiberglas is odorless and will not hold odors.**
8. **Fiberglas provides no sustenance for vermin.**
9. **Fiberglas is made in a form to meet virtually every insulation need.**
10. **Fiberglas can be applied by standard methods.**

Be sure that you have all of the facts about the use of Fiberglas for duct insulation and other requirements. Write for booklet "Fiberglas Insulations for Industry". Owens-Corning Fiberglas Corporation, Dept. 912, Toledo 1, Ohio. Branches in principal cities.

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

OWENS-CORNING

FIBERGLAS

T.M. REG. U.S. PAT. OFF.

Degree-Days for February, 1946

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

City	February			Cumulative, September 1 to February 28			Heating Season[1]
	1946	1945	Normal	1945-46	1944-45	Normal	Normal
Abilene, Texas	381	455	510	2142	2123	1761	2061
Albany, New York	1206	1124	1142	5197	5332	4868	6580
Albuquerque, New Mexico	697	621	692	3509	3265	3443	4298
Alpena, Michigan	1308	1230	1278	5604	5639	5660	8299*
Anaconda, Montana	1041	1049	1164	5435	5376	5656	8357**
Asheville, North Carolina	653	638	756	3258	3097	3276	4232
Atlanta, Georgia	491	473	557	2471	2470	2370	2890
Atlantic City, New Jersey	805	827	904	3415	3699	3631	5176
Augusta, Georgia	360	349	423	1895	1936	1864	2161
Baker, Oregon	1000	867	991	5026	4647	5024	7163
Baltimore, Maryland	751	735	843	3276	3531	3462	4533
Billings, Montana	944	1072	1120	4899	4852	5254	7119
Binghamton, New York	1115	1080	1182	4823	5191	4965	6808
Birmingham, Alabama	469	442	521	2366	2285	2023	2352
Bismarck, North Dakota	1470	1352	1548	6994	6223	6869	9192
Block Island, Rhode Island	957	929	983	3894	4055	3767	5788
Boise, Idaho	870	766	848	4336	4038	4230	5552
Boston, Massachusetts	1050	965	1042	4339	4417	4322	6045
Bozeman, Montana	1082	1066	1208	5637	5362	5897	8521**
Buffalo, New York	1130	1088	1156	4895	5111	4768	6822
Burlington, Vermont	1374	1250	1294	5771	5947	5496	7514
Butte, Montana	1113	1079	1143	5896	5646	5635	8272
Cairo, Illinois	577	701	762	3056	3274	3169	3909
Canton, New York	1473	1261	1328	6063	6204	5842	8020
Charles City, Iowa	1164	1260	1273	5807	5631	5728	7588
Charleston, South Carolina	309	314	372	1565	1672	1491	1769
Charlotte, North Carolina	507	524	588	2508	2640	2533	3120
Chattanooga, Tennessee	567	602	602	2802	2936	2559	3118
Cheyenne, Wyoming	981	1042	1075	5004	4936	5179	7466
Chicago, Illinois	981	980	1083	4542	4713	4276	5957
Cincinnati, Ohio	738	858	862	3673	4115	3675	4684
Cleveland, Ohio	956	989	1075	4345	4636	4441	6155
Columbia, Missouri	693	863	897	3827	3995	3903	4922
Columbia, South Carolina	398	394	498	2021	2093	2000	2364
Columbus, Ohio	862	903	980	4071	4346	4113	5398
Concord, New Hampshire	1318	1173	1240	5661	5598	5321	7353
Concordia, Kansas	664	876	970	3936	3908	4173	5315
Dallas, Texas	345	419	493	1917	1961	1980	2256
Davenport, Iowa	986	1033	1140	4846	4791	4825	6289
Dayton, Ohio	897	976	980	4407	4623	4043	5264
Denver, Colorado	764	847	918	3979	3897	4273	5874
Des Moines, Iowa	939	1052	1173	4859	4805	4935	6384
Detroit, Michigan	1077	1046	1134	4709	4916	4718	6490
Devils Lake, North Dakota	1698	1478	1551	7862	6747	7371	9970
Dodge City, Kansas	654	865	890	3663	3829	3958	5035
Dubuque, Iowa	1077	1124	1218	5222	5167	5194	6790
Duluth, Minnesota	1536	1407	1464	6981	6439	6680	9443
Eastport, Maine	1279	1127	1232	5502	5271	5502	8520**
Elkins, West Virginia	881	884	991	4265	4605	4256	5697
El Paso, Texas	462	379	434	2233	2063	2101	2428
Ely, Nevada	1097	1011	—	5529	5283	—	—
Erie, Pennsylvania	1026	1022	1098	4348	4552	4434	6273
Escanaba, Michigan	1325	1301	1340	5941	5901	6028	8771*
Evansville, Indiana	725	811	854	3669	3843	3348	4244
Fort Smith, Arkansas	494	601	630	2695	2636	2657	3147
Fort Wayne, Indiana	1022	1034	1098	4840	5068	4503	5925
Fort Worth, Texas	349	428	498	1934	1964	1904	2148
Fresno, California	440	396	389	2005	2032	1883	2334
Galveston, Texas	225	175	255	979	917	938	1016
Grand Junction, Colorado	880	734	863	4470	3693	4374	5548
Grand Rapids, Michigan	1102	1039	1204	4859	4859	4863	6535
Green Bay, Wisconsin	1258	1292	1358	5858	5695	5778	7825
Greensboro, North Carolina	620	645	678	3090	3221	2845	3529
Greenville, South Carolina	523	517	661	2641	2624	2739	3380
Harrisburg, Pennsylvania	926	916	1008	4069	4280	4077	5375
Hartford, Connecticut	1105	1042	1100	4758	4876	4416	6036
Hatteras, North Carolina	484	522	535	1933	2256	1851	2571
Havre, Montana	1146	1275	1450	5885	5916	6388	8700
Helena, Montana	968	1074	1178	5318	5594	5611	7898
Houston, Texas	216	195	277	1121	1088	1092	1157
Huron, South Dakota	1266	1209	1340	6171	5597	6075	8004
Indianapolis, Indiana	857	884	969	4127	4268	4099	5298
Jackson, Miss.	367	341	—	1884	1859	—	—
Kansas City, Missouri	651	840	946	3743	3767	3953	4956
Kewanee, Illinois	988	997	1106	4641	4637	4640	6139
Knoxville, Tennessee	592	596	666	2945	3053	2964	3670
La Crosse, Wisconsin	1260	1210	1265	5981	5398	5578	7322
Lander, Wyoming	1004	1148	1155	5642	6181	5666	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table Concluded on page 112]

How far down is "down to earth"?

BUSINESS in general, and the building industry in particular, seems to have its feet firmly planted in mid-air! In view of the present muddle, this isn't the least bit surprising. But we sometimes wonder if there aren't a lot of people up in the air who with just a little effort could get back on the ground.

Take your business and our business, for example. Look way off into the distance for the big, new-building program and you see all kinds of complications. But look around the home community and you see a lot of war-neglected heating plants that need plenty of face lifting right now. As a matter of fact, we doubt if anyone who seriously goes after this much needed remodeling and modernization will need to care much about big-scale building for a long time to come.

McDonnell Boiler Feeders and Low Water Cut-offs are mighty important equipment in such remodeling and modernizing jobs, and of course you can't put them in any faster than we can supply them. But shipments are going out faster all the time now and it won't be long until we, too, are down to earth and on our old-time, same-day-shipment schedule.

So sell the Sam-you-better-scram idea. McDonnell products are better than they ever were and are being turned out faster. Ask for latest catalog and price schedule.

McDONNELL & MILLER, 1313 Wrigley Bldg., Chicago 11, Illinois

Doing One Thing Well

REG. U. S. SAFETY CONTROLS PAT. OFF.

McDONNELL

Degree-Days for February, 1946 (Concluded)

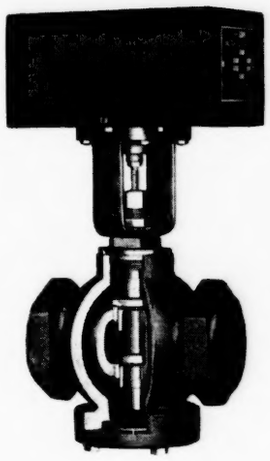
HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

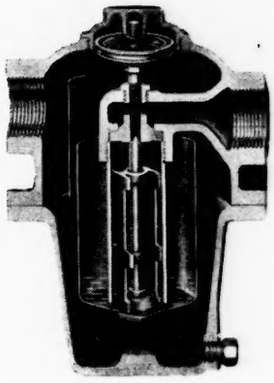
CITY	FEBRUARY			CUMULATIVE, SEPTEMBER 1 TO FEBRUARY 28			HEATING SEASON[1]
	1946	1945	NORMAL	1945-46	1944-45	NORMAL	NORMAL
Lansing, Michigan	1147	1109	1201	5163	5349	5202	7048
Lewiston, Maine	1319	1231	1243	5843	5690	5532	7707
Lincoln, Nebraska	785	944	1131	4326	4293	4643	5999
Little Rock, Arkansas	464	603	582	2543	2651	2380	2811
Livingston, Montana	940	1010	1067	4930	4953	5018	7205
Los Angeles, California	288	244	266	925	888	1016	1504
Louisville, Kentucky	670	775	801	3363	3650	3327	4180
Lynchburg, Virginia	677	700	730	3321	3541	3143	3980
Macon, Georgia	374	338	462	1953	1956	1908	2201
Madison, Wisconsin	1184	1197	1299	5580	5482	5557	7429
Marquette, Michigan	1340	1242	1361	5943	5737	5915	8693*
Memphis, Tennessee	507	584	599	2671	2770	2470	2950
Meridian, Mississippi	381	382	456	1915	2000	1891	2160
Milwaukee, Wisconsin	1121	1126	1201	5180	5226	5185	7245
Minneapolis, Minnesota	1352	1326	1400	6228	5748	5950	7850
Modena, Utah	950	849	905	4653	4487	4764	6562
Montgomery, Alabama	327	308	392	1779	1663	1676	1884
Nantucket, Massachusetts	970	925	974	3889	3971	3912	5957
Nashville, Tennessee	587	649	675	3012	3148	2850	3507
New Haven, Connecticut	1033	994	1011	4428	4549	4230	5895
New Orleans, Louisiana	195	158	230	1041	933	965	1024
New York, New York	940	857	960	3799	3984	3869	5347
†Nome, Alaska	1559	1466	1990	6946	6458	7226	14580**
Norfolk, Virginia	560	586	650	2505	2764	2583	3350
North Head, Washington	613	572	622	3169	2736	3132	5452**
North Platte, Nebraska	793	937	1020	4405	4439	4806	6366
Oakland, California	501	381	403	2113	1961	2029	3143**
Oklahoma City, Oklahoma	483	673	742	2714	2803	2986	3613
Omaha, Nebraska	877	1016	1126	4670	4606	4765	6131
Oswego, New York	1186	1072	1162	4967	5132	4933	7088
Parkersburg, West Virginia	782	841	879	3669	4111	3701	4775
Peoria, Illinois	957	991	1067	4759	4785	4673	6109
Philadelphia, Pennsylvania	829	804	893	3553	3780	3629	4855
Phoenix, Arizona	303	243	263	1348	1222	1253	1405
Pittsburgh, Pennsylvania	844	867	944	3900	4200	3947	5235
Pocatello, Idaho	1025	891	986	5179	4900	4853	6655
Portland, Maine	1285	1201	1162	5604	5534	5088	7218
Portland, Oregon	567	534	644	3905	2811	3174	4469
Providence, Rhode Island	1008	944	1070	4204	4282	4316	6015
Pueblo, Colorado	769	856	916	4173	4118	4140	5514
Raleigh, North Carolina	539	563	630	2629	2830	2605	3234
Rapid City, South Dakota	909	1132	1119	4948	5042	5140	7118
Reading, Pennsylvania	908	880	980	3924	4168	4082	5389
Red Bluff, California	542	377	—	2186	1937	—	—
Reno, Nevada	852	778	823	4092	4077	4149	5892
Richmond, Virginia	624	648	695	2997	3155	2906	3695
Rochester, New York	1164	1113	1159	5010	5300	4825	6732
Roseburg, Oregon	581	527	605	2831	2755	3090	4428
Roswell, New Mexico	558	487	580	2752	2643	2876	3484
Sacramento, California	490	360	426	2035	1959	2036	2653
St. Joseph, Missouri	695	880	974	4047	4031	4121	5161
St. Louis, Missouri	682	827	854	3594	3799	3652	4585
Salt Lake City, Utah	856	778	885	4421	3749	4144	5555
San Antonio, Texas	269	278	274	1389	1437	1128	1202
San Diego, California	296	232	280	983	929	1099	1645
Sandusky, Ohio	961	986	1061	4328	4653	4384	6208
San Francisco, California	398	302	356	1703	1646	1770	3264**
Sault Ste. Marie, Michigan	1479	1351	1487	6494	6416	6315	9285**
Savannah, Georgia	279	240	316	1440	1395	1323	1490
Scranton, Pennsylvania	1050	1022	1106	4518	4917	4552	6129
Seattle, Washington	576	568	647	2978	2758	3297	4934**
Sheridan, Wyoming	1048	1149	1160	5165	5156	5789	8008
Shreveport, Louisiana	342	364	412	1864	1911	1736	1938
Sioux City, Iowa	1032	1114	1260	5363	5073	5278	6898
Spokane, Washington	832	837	952	4540	4300	4707	6355
Springfield, Illinois	833	884	1008	4132	4645	4191	5373
Springfield, Missouri	642	825	876	3563	3714	3523	4428
Syracuse, New York	1171	1083	1212	5046	5283	4980	6893
Tacoma, Washington	603	604	675	3265	3059	3438	5181**
Terre Haute, Indiana	814	850	966	4016	4132	3876	4872
Toledo, Ohio	1016	1051	1075	4725	5104	4467	6077
Topeka, Kansas	621	843	935	3713	3742	3953	4969
Trenton, New Jersey	898	865	941	3837	4102	3715	4933
Utica, New York	1132	1143	1181	5220	5635	4966	6796
Valentine, Nebraska	932	1090	1130	4972	5149	5225	7039
Walla Walla, Washington	625	646	778	3384	3441	3676	4808
Washington, D. C.	716	743	848	3309	3582	3559	4626
Wichita, Kansas	587	830	896	3464	3521	3773	4673
Williston, North Dakota	1434	1308	1495	7014	6195	6958	9323
Winnemucca, Nevada	883	802	905	4426	4444	4644	6427**
Yakima, Washington	742	709	846	3970	3822	4433	5599

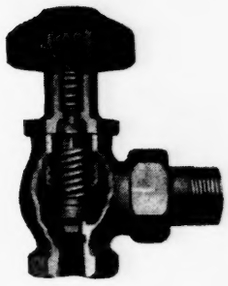
†Nome data are for January.

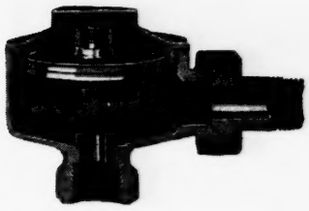
*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.





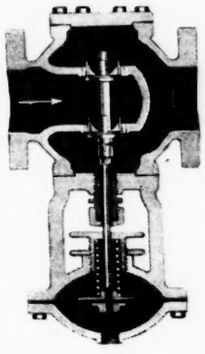




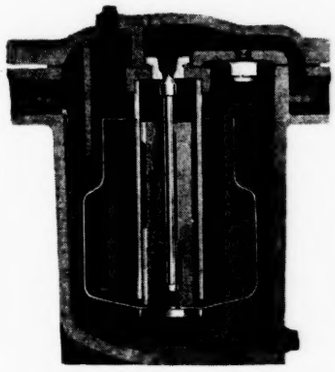
ILLINOIS

Automatic

Steam and Fluid Control Equipment



Illinois Control Equipment includes Combustion Control, Flow Control (electrical or pneumatic), Zone Control and a complete line of steam heating and power specialties for heating comfort and fuel saving and for industrial process control as well.



"ILLINOIS" is your logical, dependable source of supply for heating and power specialties that have been carefully engineered, thoroughly proved and have a performance record that is beyond question.

Our representative nearest you in our nation-wide service will give you full information.

Write for bulletins.

ILLINOIS ENGINEERING COMPANY

INCORPORATED 1900

RACINE AVENUE AT 21ST STREET • CHICAGO 8

ABSTRACTS AND REVIEWS

ASHVE GUIDE

A new edition of the Heating Ventilating Air Conditioning Guide published by the American Society of Heating and Ventilating Engineers, has been published. The technical text contains 51 chapters grouped under the general section headings of Principles, Human Reaction to Atmospheric Environment, Heating and Cooling Loads, Combustion and Consumption of Fuels, Heating Systems and Equipment, Air Conditioning, Special Applications, and Installation and Testing Codes. New chapters have been added on fluid flow, and on owning and operating costs. A listing of more than 75 codes for testing, rating, selecting and installing heating, ventilating and air conditioning equipment has been added to the chapter on Codes and Standards.—*1946 ASHVE Guide. Cloth bound 6 x 9 in., 1280 pages. Published by American Society of Heating and Ventilating Engineers. Price, $6.*

RESISTANCE WELDING.—This is a compilation of recommended practices for the spot and seam welding of low-carbon, stainless and hardenable steels, nickel, monel and inconel; the projection welding of low-carbon and stainless steels; flash-butt welding low and medium forging strength steels; and standard methods for testing resistance welds. Each recommended practice comprises a table of machine settings for current, voltage, time, pressure, and other factors, which will produce welds of specified strength in various thicknesses of materials. Explanatory text on each of the factors is included. The section on standard methods for testing resistance welds covers tests for tensile properties, shear strength, impact strength, fatigue properties and hardness. Copies may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N. Y., at 50c per copy.

AUTOMATIC REGULATING VALVES.—A simplified practice recommendation R219-46, for automatic regulating valves, is being distributed by the National Bureau of Standards. Automatic regulating valves are used in industry for controlling temperature, pressure, level or rate of flow of fluids, and R-219-46 is to establish as a useful standard of practice in the industry a simplified list of pressure ratings and sizes of seven types of valves made of steel, iron and bronze. Mimeographed copies of R219-46 may be obtained without cost from the Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.

NEW CATALOGS

Stainless Steel

A handbook on stainless steel presents 100 paper-bound pages of data on the properties, metallurgy, welding, forming, etc., of various types of stainless steel. Corrosion resistance tables and some convenient conversion tables are included.—*Allegheny Ludlum Steel Corp., Brackenridge, Pa.* 1

pH Equipment

A new bulletin, No. pH1302, describes a line of pH control instruments, including electrode assemblies and accessories. The bulletin includes engineering and technical information relative to pH theory and measurement. A variety of actual installations are described; with chart records, photographs, and flow diagrams included.—*The Bristol Co., Waterbury 91, Conn.* 2

Sheet Metal

"Armco Aluminized Steel" is the title of a 24-page booklet that describes one of Armco's newest special-purpose sheet steels for resistance to heat and corrosion. Aluminum-coated on both sides, Aluminized Steel is said to resist destructive heat scaling up to 1500F and to maintain a bright shiny appearance after prolonged heating up to 900F. It has good atmospheric corrosion resistance, and good radiant heat reflectivity. The booklet is fully illustrated with charts, photographs and tables, and contains sections on heat reflectivity, mechanical properties, forming properties, painting and finishing, electrical conductivity, welding, brazing, soldering.—*The American Rolling Mill Co., 939 Armco Ave., Middletown, Ohio.* 3

Plates for Refrigeration

Catalog No. G-461, 18 pages, describes serpentine plate type evaporators, plate banks, stands, cabinet, fountain and trap installations. Booklet also includes engineering data and instructions for computing serpentine plate requirements. A section on mounting accessories is included.—*Kold Hold Mfg. Co., Lansing 4, Mich.* 4

Stokers

The new booklet "How To Choose A Stoker," has been published to provide helpful information regarding the homeowner's problem of stoker selection. This sales piece for Whiting Stokers presents an objective analysis of stoker theory and construction, written in terms the average man —or woman—can understand.—*Whiting Stokers, Suite 2667, 11 S. LaSalle St., Chicago 3, Ill.* 5

Motor Service

To meet all requirements of appliance and machinery manufacturers, three service plans that provide 100 percent service coverage for all fractional horsepower motors are explained in a new booklet (B-3711) announced by the Westinghouse Electric Corp. The new 12-page booklet describes in detail all three of these plans, tells who is entitled to use them, how they operate, and what can be accomplished when they are properly used.—*Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.* 6

Central Heating

"Every building in the vast Firestone Industrial Community at Akron, Ohio, obtains Steam and Electricity from One Central Source" is the title of a study of the application of central heating in industry. Besides describing steam distribution for the Firestone buildings in general, the study shows in detail—with installation photographs, blueprints and specifications—how the new Firestone Research Laboratory, over a mile from the Boiler Plant, was connected to the existing steam lines with Ric-wiL prefabricated conduit. Special services for the laboratory, one of the most modern of its kind in the world, are also described.—*The Ric-wiL Co., Union Commerce Building, Cleveland, Ohio.* 7

Ducts and Fittings

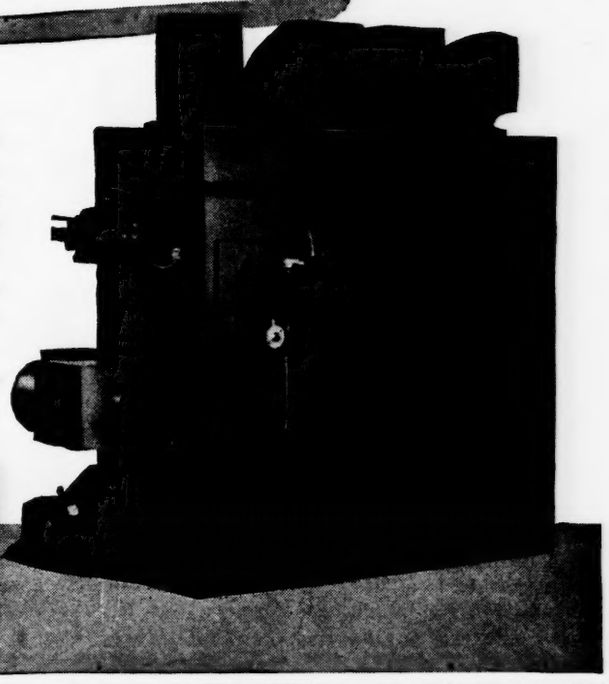
A catalog-manual showing methods for installing fittings for heating and air conditioning units carries instructions illustrated and keyed to show the correct prefabricated duct or galvanized fittings to be used for both round and rectangular systems for forced or gravity warm-air heating.—*Clayton & Lambert Manufacturing Co., Middletown, Ohio.* 8

Cork Products

Pressed cork for cold storage plants, cold pipe covering, roof insulation, and vibration isolation described and illustrated in a 12-page folder.—*Mundet Cork Corp., 65 S. 11th St., Brooklyn 11, N. Y.* 9

THE NEW AIRTHERM DIRECT FIRED WARM AIR HEATER

Costs Less to Install



The lighter weight of the new Airtherm Direct Fired Warm Air Heater means less structural work in installation, resulting in a saving in original installation costs. This lighter weight is particularly advantageous in installations calling for either vertical or horizontal wall or ceiling mounting.

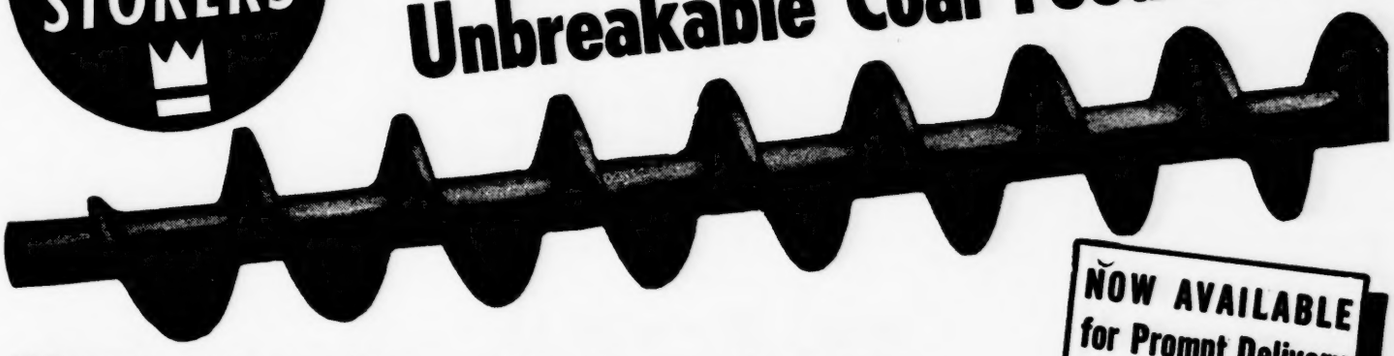
The low internal resistance through this new heater requires a minimum of motor horsepower, per B.T.U. output, reflecting a saving in power costs to the user.

Write for bulletin 801 describing the new Airtherm Heater in detail.

AIRTHERM
MANUFACTURING COMPANY
722 S. Spring Avenue, St. Louis 10, Mo.

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY
1207 Tyler St., N. E. *Since 1878* Minneapolis, Minn.

Valve Design

A booklet of questions and answers pertaining to valve design, construction, application, and care, with other factual information directed to the design engineer and the user of valves. This booklet contains cross-sectional diagrams of various types of valves and describes the functions of each.—*The Wm. Powell Co., 2503-31 Spring Grove Ave., Cincinnati 22, Ohio.* 10

Registers and Grilles

A 52-page, paper bound booklet describing a variety of grilles and registers for warm air systems, air conditioning lines, etc. Also included is a section devoted to furnace regulator sets, damper regulators, and other accessories. Text includes data sheets on installation, location, dimensions, etc.—*Hart & Cooley Mfg. Co., Holland, Mich.* 11

Mechanical Packings

A new book on the selection of mechanical packings types, their application and the design of adjacent parts in hydraulic or pneumatic equipment. Both leather and synthetic rubber packings are discussed and operating conditions governing the selection of material are enumerated. —*Graton & Knight Company, Worcester 4, Mass.* 12

Pumps

A new pump catalog covering the Eastern Engineering line of Midget Pumps and Laboratory Stirrers has been printed. This is the first new literature on small pumps printed by this company since before the war. It contains descriptions and illustrations of many new models both for regular industrial use and special types recently developed. In addition it includes the Eastern line of laboratory stirrers.—*Eastern Engineering Co., New Haven, Conn.* 13

Pipe Thread Standards

An eight-page booklet containing information on the recently set up standard for improvement in pipe threads, known as Dryseal Pipe Threads, has been made available. The Weatherhead Co. also announces that all Ermeto, inverted, S.A.E. and compression tube fittings using a pipe thread on some portion of the fittings, will henceforth be supplied with Dryseal Pipe Threads. The Dryseal booklet referred to above contains information which explains what dryseal pipe threads are, how they work, and recommended practices.—*The Weatherhead Co., 300 East 131st St., Cleveland 8, Ohio.* 14

Coal Burning

Centralizing on the thought that "Coal heat adds selling value to homes," the bituminous coal industry, represented by the National Coal Association, organization of bituminous coal operating and shipping companies, is making literature available covering the whole field of apparatus and installations necessary in order to obtain most satisfactory results from burning coal. Key booklet in the offering is "Why Coal Heat Adds Selling Value to Homes" which includes reference to other literature and technical data available.—*National Coal Association, 307 N. Michigan Ave., Chicago 1, Ill.* 15

Soft Water

The benefits and economies of soft water are presented in new bulletin 607, which describes Elgin Water Softeners and other water conditioning equipment and features Elgin's newest water softener of "Double Check Design," in which additional zeolite means a comparable increase in the amount of soft water delivered. A section of the bulletin tells how to modernize existing water softeners. Data on treating water correctly for boilers, lines, auxiliaries and processing are given in another section.—*Elgin Softener Corp., Elgin, Ill.* 16

Rivnut

A 10-page booklet on the development of the Rivnut, entitled Why A Rivet Went Nuts tells how engineers, faced with the problem of attaching rubber de-icers to the metal skins of modern airplanes developed the Rivnut and gave it its name because it can serve as rivet and nut plate. It was originally made only in aluminum and used in the aeronautical industry, but now is made also in brass, steel and stainless steel with many head styles and a variety of applications.—*B. F. Goodrich Co., Akron, Ohio.* 17

Insulation

A new circular on Careycel, an asbestos heat insulation, entitled "Careycel, Improved Heat Insulation," has been developed to facilitate the specification and purchase of light weight, heat insulation for commercial and industrial use.—*The Philip Carey Mfg. Co., Lockland, Ohio.* 18

Water Coolers

A 2-color booklet contains information on the post-war line of Sunroc AC and DC Water Coolers, for business, industrial, and institutional use. All Sunroc models are illustrated, and specifications of each are given.—*Dept. A-45, Sunroc Refrigeration Co., Glen Riddle, Pa.* 19

Automatic Clutch

Bulletin No. 4501 describes in detail a new automatic clutch. Designed for operating loads up to 6 hp, this clutch operates smoothly and easily, absorbs momentary overload, eliminates starting shock and arrives quickly at driving speed.—*Salsbury Motors, Inc., 4464 District Blvd., Los Angeles 11, Cal.* 20

Welding Electrodes

A strip folder (DM-710) announcing the Hobart post-war line of arc welding electrodes. This pocket size folder furnishes description, application, procedure, physical properties of deposited metal, and sizes available for each type electrode in this new post-war line.—*The Hobart Brothers Co., Troy, Ohio.* 21

Oil Burners

A two-color booklet describing industrial and residential oil burners. Typical installations and piping plans are included. This booklet describes the Enterprise belt drive burners.—*Enterprise Engine & Foundry Co., Combustion Equipment Div., 18th and Florida Sts., San Francisco 10, Calif.* 22

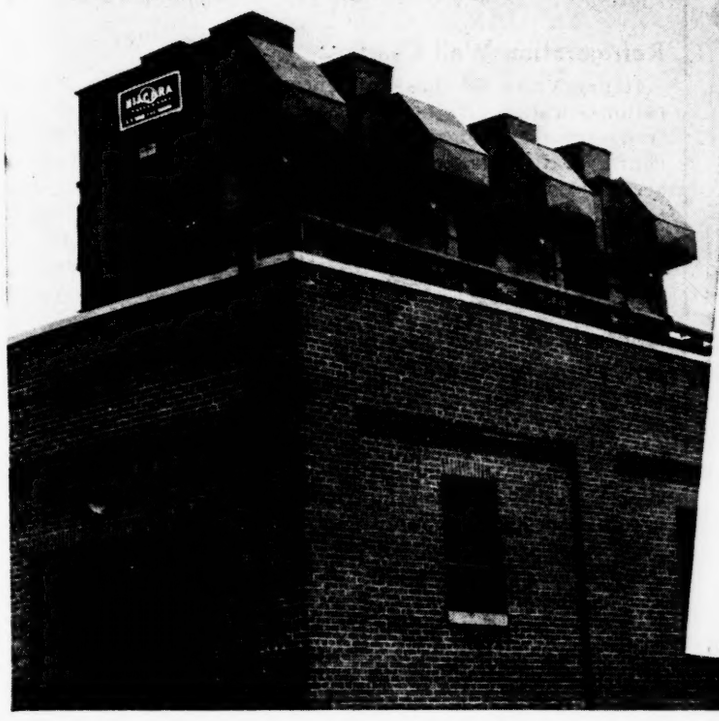
Uses of Wrought Iron

Numerous photographs depicting the utilization of wrought iron piping, bars and flat rolled products in the plumbing, heating and refrigerating industries are included in the revised edition of "101 Uses for Wrought Iron," issued by A. M. Byers Company, Pittsburgh. Among the newer applications for wrought iron as shown in the book are radiant heating and automatic snow melting systems.—*A. M. Byers Co., Pittsburgh, Pa.* 23

Transformers

A new bulletin, "Electrical Power, Disciplined," contains a complete discussion of the construction and operating theory of the constant voltage transformer, engineering and operating data, a survey of line conditions that make constant voltage transformers necessary and a section devoted to new developments. In addition, it contains many suggestions pertaining to the practical use of constant voltage transformers as a built-in component of electronic and electrically operated instruments and equipment. The catalog section lists 31 standard types in capacities ranging from 15VA to 10,000VA with complete electrical and mechanical specifications.—*Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill.* 24

Get full capacity from your Refrigeration Plant!



For as long as six years NIAGARA Duo-Pass AERO CONDENSERS have given their owners the benefits of greater production, and power and water savings without the loss of a single day's shut-down for cleaning.

That is because the action of the patented Niagara Duo-Pass always keeps the condensing surface clean, preventing the precipitation of salts or deposits of scale; the result is always full condensing capacity.

In addition, because the heat is transferred to air, not water, users benefit from the saving of nearly the full amount of condenser water.

Write for Bulletin 91 for complete information.

NIAGARA BLOWER COMPANY
Over 30 Years of Service in Industrial Air Engineering
DEPT. HV-46, 6 E. 45th St., NEW YORK 17, N. Y.
Field Engineering Offices in Principal Cities

NIAGARA "NO-FROST" COOLING SYSTEMS
AIR ENGINEERING EQUIPMENT

Competitive in First Cost. Much Lower in Final Cost.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See Sweet's Architectural File, or, The Heating Guide.

THERM-O-TILE
Reg. U. S. Pat. Off.
Underground Pipe Conduit

H. W. PORTER & CO., INC.,
823-V Frelinghuysen Ave., Newark 5, N. J.

- ☐ Enclosed is a sketch of a prospective underground pipe.
- ☐ We shall be glad to have your quotation.
- ☐ We shall be glad to have your comments.
- ☐ Please send representative.
- ☐ Please send Bulletin 381.

Fill in Clip Out and Mail

Name.....
Firm.....
Street.....City.....State.....

1 A COMPLETE LINE

2 YEARS OF EXPERIENCE

3 PERSONAL COOPERATION

4 ENGINEERING LEADERSHIP

5 FINANCIAL STRENGTH

6 AGGRESSIVE PROMOTION

FREEMAN STOKER DIVISION
ILLINOIS IRON & BOLT CO.
918 S. MICHIGAN AVE., CHICAGO 5, ILLINOIS

Ship Ventilation

A pictorial history of Ilg applications in the ventilation of ships showing the development of ship ventilation between World War I and World War II.—*Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.*.....25

Refrigeration Wall Charts

Henry Valve Co. has announced the publication of educational wall charts now available without cost to colleges, trade schools, and manufacturers' service schools. These charts feature large, clear cross-section views of typical accessories used in refrigeration and air conditioning; the text is factual and informative; the charts contain no advertising. They are available to firms and institutions requesting them on their own letterheads.—*Henry Valve Co., 3260 W. Grand Ave., Chicago 51, Ill.*.....26

Controls Manual

A 36-page manual describing radiant and hot water heating controls and hook-ups. Written in more or less popular style, this manual describes the application of controls to hot water and radiant heating systems. Sarcotherm controls are used at various points throughout given installations and the specifications governing their selection are carefully described. Temperature, time, velocity, and other types of controls are shown in diagram and their applications are illustrated with installation layouts. Capacity charts for hot water heating are also included.—*Sarcotherm Controls, Inc., 280 Madison Ave., New York 16, N. Y.*....27

Float Controls

A folder, Catalog No. 46, and series of leaflets, loose-leaf style, describing float controls and their applications in various types of refrigeration.—*H. A. Phillips & Co., 3255 W. Carroll Ave., Chicago 24, Ill.*.....28

Aluminum

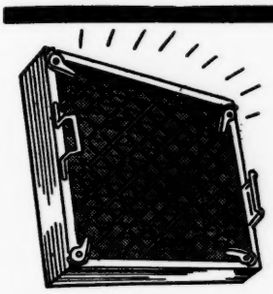
Catalog Nos. 100A, 102 and 103A describe the role of aluminum in processing operations, engineering design, and product manufacture. Each catalog carries illustrations of the uses of aluminum, its alloying characteristics, and tables of specifications and other data.—*Reynolds Metals Co., Aluminum Div., 2500 S. 3rd St., Louisville 1, Ky.* ...29

Automatic Valves

A loose-leaf type folder containing descriptions and illustrations of the Electrimatic line of automatic control and regulating valves. Various pages are devoted to applications in refrigeration and technical data for refrigeration condensing water regulators.—*The Electrimatic Div., The Simoniz Co., 2100 Indiana Ave., Chicago, Ill.*.....30

Air Coolers

A series of 4 folders describing evaporative condensers, air conditioning units, and unit coolers. Each folder gives tables of capacities and other data.—*Governair Corp., 617-631 N.W. 2nd St., Oklahoma City, Okla.*.....31



Easier Way to Clean Air Filters

Efficiency of air conditioning units is largely dependent on periodic cleaning of air filters . . . regular, complete removal of deposits entrapped from the air is necessary to maintain high filtering capacity.

If your filters are of the dry or viscous impingement washable type, you can clean them easily and effectively by using Oakite materials specially designed for this work. Dirt, dust, soot, lint, pollen and other foreign matter collected on surfaces are thoroughly removed . . . full filtering capacity is quickly restored . . . equipment out-of-service time is reduced to a minimum.

Dependable Oakite materials and techniques are available for expediting other essential air conditioning maintenance jobs. Write us concerning your problems. There's no obligation.

OAKITE PRODUCTS, INC., 58A Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Conveniently Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**

MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT

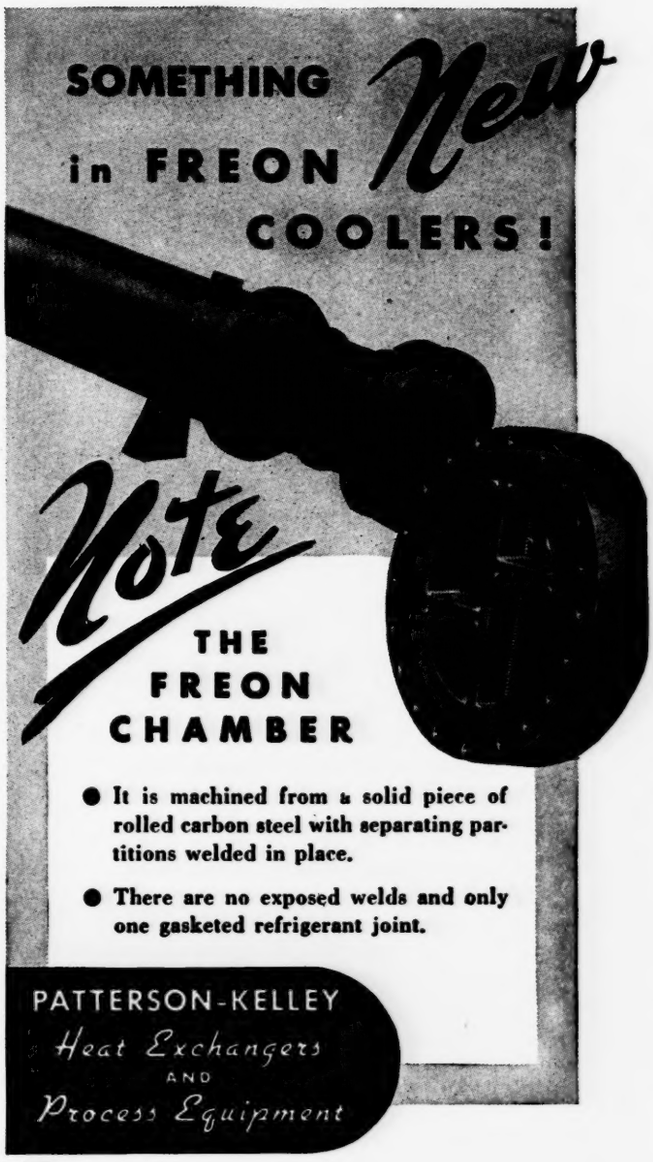
PRESSURE, TEMPERATURE, FLOW, ELECTRICAL AND LEVEL MEASURING INSTRUMENTS

UNITED STATES GAUGE

6 out of 10 manufacturers of original equipment specify U. S. G.

DIVISION OF AMERICAN MACHINE AND METALS, INC.

SELLERSVILLE, PENNSYLVANIA (4)



This Freon Chamber represents a marked advance in the design and construction of coolers. It is an indication how wide awake Patterson-Kelley engineers are to the trends . . . how well they have anticipated the industry's requirements in Freon Coolers.

Designed primarily as a Dry Expansion Water Cooler, this unit in modified form is applicable to general refrigeration needs using calcium chloride brine, ethylene glycol, alcohol, propylene glycol and other liquids.

If required, it can be constructed of stainless steel, Monel, nickel or other corrosion-resisting metals.

With the many variations of this Cooler and a complete line of Flooded Coolers and Refrigerant Condensers, we are equipped to serve you in a broad way. We shall be glad to help you with both design and application problems as well as to manufacture to your requirements.

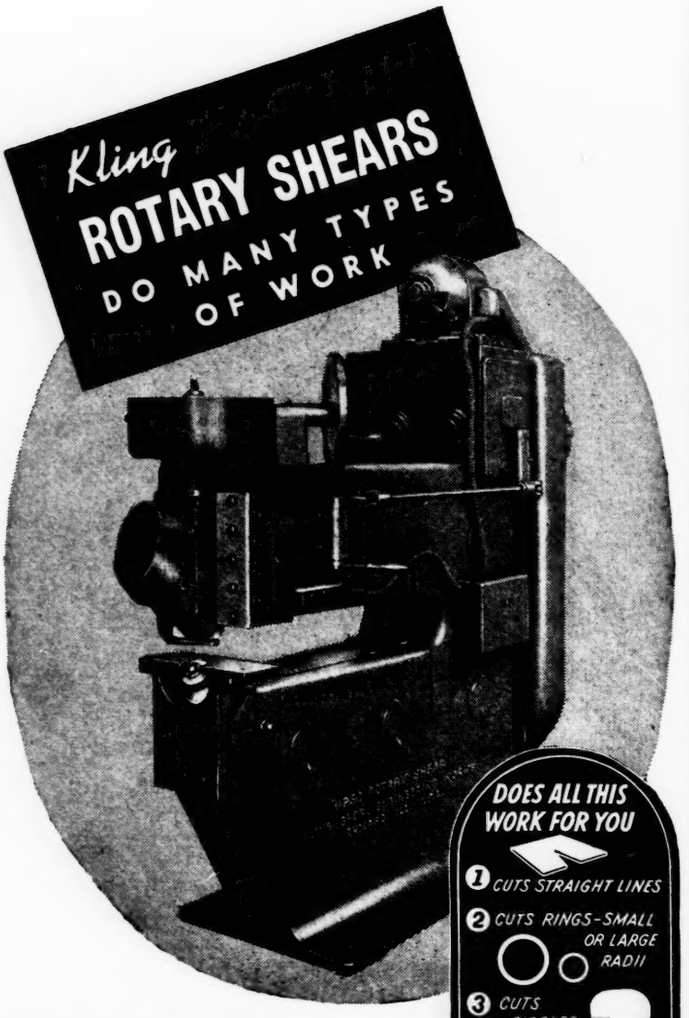
EST. 1880

THE PATTERSON-KELLEY Company, Inc.

122 WARREN STREET, EAST STROUDSBURG, PA.

BOSTON 16, 96-A Huntington Avenue • NEW YORK 17, 101 Park Avenue
PHILADELPHIA 3, 1700 Walnut Street • CHICAGO 4, Railway Exchange Building

Representatives in All Principal Cities


Kling
ROTARY SHEARS
DO MANY TYPES OF WORK
DOES ALL THIS WORK FOR YOU
1 CUTS STRAIGHT LINES
2 CUTS RINGS-SMALL OR LARGE RADII
3 CUTS CIRCLES
4 MAKES FLANGES
5 CUTS INSIDE HOLES WITHOUT CUTTING IN FROM EDGES
6 JOGGLES & OFFSETS
7 CUTS ODD SHAPES
8 BEVELS OF ANY ANGLE
9 CUTS REVERSE CURVES
10 BEADS & U'S
ALL WITH Hairline PRECISION

Yes, and With Hairline Precision

Rapid operation . . . Hairline Accuracy . . . the use of Kling Rotary Shears marks the latest development in cutting mild steel, and sheet metal, up to 1-inch with amazing savings in time, labor, and production costs.

For exacting projects (see illustration at the right), no single unit of metal-working equipment does so many different things so cleanly and efficiently as does the Kling Rotary, pictured above.

In metal working plants, automotive, aviation, home appliance, and other industries, where work of this character is being done, — this machine is held in high regard for its versatility and economy of operation.

This great usefulness is the result of half-a-hundred years of engineering experience which prospective buyers, with reason and respect, applaud.

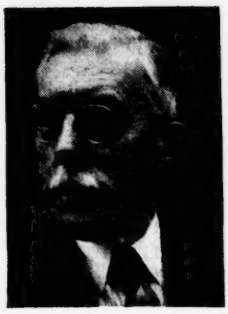
Send Today for **Bulletin No. 245** which will give you specific facts, and specifications. No obligation involved. Users of heavy equipment of Kling Rotary Shears' class will receive a copy of this Bulletin promptly, on request.

KLING BROS. *Engineering Works*

1304-HV No. Kostner Ave., Chicago 51, Illinois

EXPORT DEPT. 1111 South Ferry Building, New York 4, N. Y.

Getting Personal



C. H. Herter

Born in Switzerland, **Charles H. Herter** *(Design of Ice Skating Rinks*, page 57) came to New York in 1889. He entered the employ of De La Vergne Machine Co., builders of large refrigerating machines and internal combustion engines. He worked his way up through the shops, drafting rooms, sales department and when he left in 1918, he was their research engineer.

Mr. Herter acquired other engineering experience with the Cleveland Ice Machine Co., Johns-Manville, Brunswick-Kroeschell Co., Kelvinator, Copeland and with various consulting engineers including Stone & Webster. During 1924 he prepared plans and specifications for a 1,200-ton refrigerating plant for New York City's Bronx Terminal Market. During 1925-27 he was a supervising engineer in New York City.

He visited machine works in Europe in 1930 to negotiate the manufacture of American designed flakice machines. In 1935 he designed air-gas heat exchangers for high altitude mines in Peru. Since 1935 he has been with Henry Phipps Estates and Pittsburgh Building Co., New York, as construction engineer for a number of their industrial and business buildings, including power, heating, air conditioning, refrigeration and ice skating.

His society activities include 14 years with the New York Chapter, National Association of Practical Engineers, either as secretary or instructor. He is a life member of the American Society of Refrigerating Engineers, and a former member of Heat Transmission Committee, National Research Council, Washington, D. C.

His photograph belies the fact that last September he observed his golden wedding anniversary.

J. E. York

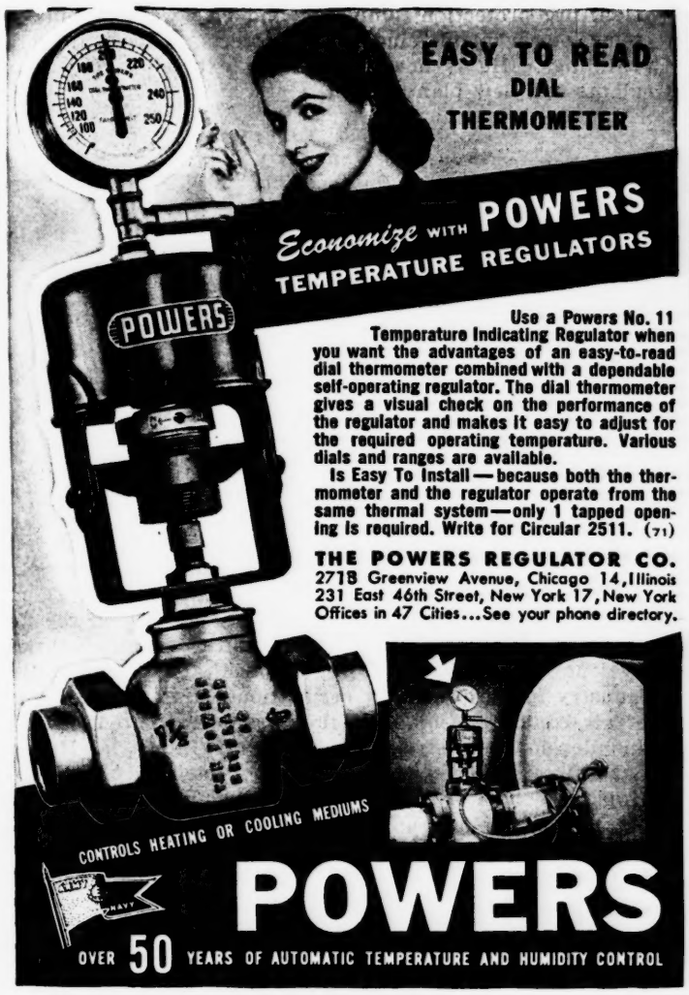
J. E. York *(Unit Heaters—Steam and Hot Water Type*, page 67), was born in Bridgenorth, Shropshire, England, and came to America when 8 years old. During the period 1910-16 he studied drafting evenings, and took courses in mechanical, electrical and structural engineering at the Lowell Institute evening school in Boston.

In 1916 he was designer on mechanical equipment and piping for power stations, for S. M. Green Co., Springfield, Mass.; 1917, designer and checker on mechanical equipment and piping for power stations, with Hope Engineering Co., Boston.

In 1918 although his local draft board rejected him for service in the U. S. Army, he enlisted in the Canadian Engineers and entered the Officers' Training Class.

The following year he was with Jarvis Engineering Co., Boston, designing and supervising installation of refrigeration plants and piping; 1920, he designed and supervised installation of power plant, industrial equipment and piping for Goodrich Rubber Co., Akron, Ohio, and equipment and piping for United Drug Co., Boston; 1920-23, engineered and supervised installation of refrigeration, fire protection and plumbing systems for Hollis French and Allen Hubbard in Boston.

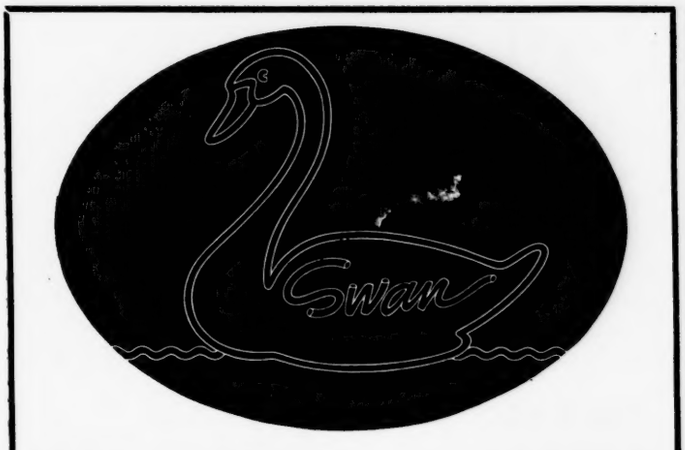
From 1924 to the present, with the exception of the depression years of 1932-35, he has been with Stone & Webster Engineering Corp., as a designer, engineer and field supervisor on heating, ventilation, air conditioning, refrigera-



Use a Powers No. 11 Temperature Indicating Regulator when you want the advantages of an easy-to-read dial thermometer combined with a dependable self-operating regulator. The dial thermometer gives a visual check on the performance of the regulator and makes it easy to adjust for the required operating temperature. Various dials and ranges are available.

Is Easy To Install—because both the thermometer and the regulator operate from the same thermal system—only 1 tapped opening is required. Write for Circular 2511. (71)

THE POWERS REGULATOR CO.
2718 Greenview Avenue, Chicago 14, Illinois
231 East 46th Street, New York 17, New York
Offices in 47 Cities...See your phone directory.

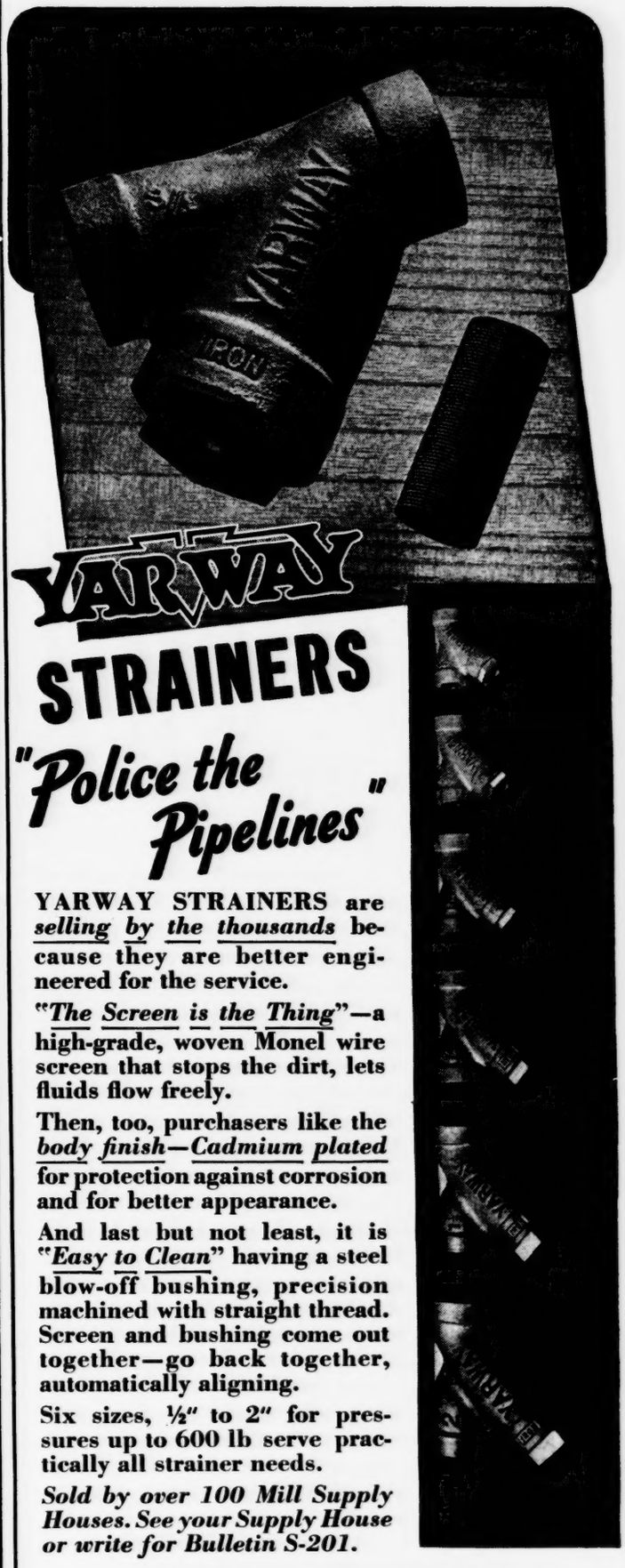


PIPE and TUBE BENDING
WELDING FABRICATION

Many foremost manufacturers, having discovered our specialized skill in our particular line, have entrusted us with a great variety of precision pipe and tube work, including bending, coiling, expanding, flattening, brazing and welding.

Swan engineers and technicians, dealing continually with piping, can advise on your bending requirements and offer valuable suggestions on design and economical methods of installation. We invite your inquiries.

SWAN ENGINEERING CO., Inc.
20-58 NELSON ST., BLOOMFIELD, N. J.



YARWAY STRAINERS

"Police the Pipelines"

YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

"*The Screen is the Thing*"—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.

Then, too, purchasers like the *body finish—Cadmium plated* for protection against corrosion and for better appearance.

And last but not least, it is "*Easy to Clean*" having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

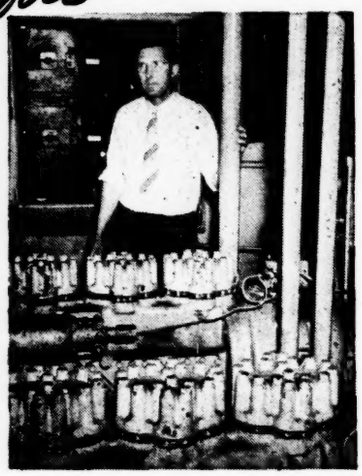
Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-201.

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

Shopping Comfort

. . . Defies Georgia's Summer Heat for Customers of Large Macon STORE* . . . With A-P VALVES Controlling the Cooling System.



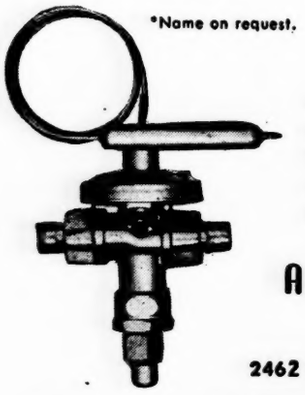
Mr. H. L. Brown of Brown-Starr Electric Co., Macon, inspects store cooling system.

TEN YEARS of highly dependable service in controlling the cooling system of a leading chain store in Macon, Georgia, is credited to A-P Refrigeration Valves by Macon's Brown-Starr Electric Co. who services the installation.

Writes **BROWN-STARR'S Mr. H. L. Brown:** "The job shown in the picture is the installation at a large store here in Macon. I have used A-P Valves on this job to control the cooling system for the last ten years. In the fifteen years I have been using A-P Valves, I have always found them to be very satisfactory."

Because they afford a wide range of adaptability, every standard A-P Refrigerant Valve can be used on Air Conditioning, Commercial Temperature, and Low Temperature installations without need for special attachments or for changing valves. This permits the use of one standard A-P Valve to fit a wide variety of applications.

*Name on request.



A-P Model 215 Thermostatic Expansion Valve. Capacity—up to 16.1 tons Freon and 32.1 tons Methyl Chloride.

AUTOMATIC PRODUCTS COMPANY

2462 N. 32nd St., Milwaukee 10, Wis.

DEPENDABLE *Refrigerant Valves*

Stocked and Sold by Good Refrigeration Jobbers Everywhere. Recommended and Installed by Leading Refrigeration Service Engineers.

tion, fire protection, plumbing and city water supply systems, power plants, industrial projects, schools and other buildings. He is now engaged on extensions to existing plants and new plant design.

B. F. Postman

B. F. Postman *(Engineering Control of Welding Exposures,* page 82) is a graduate of the Polytechnic Institute of Brooklyn, New York, with a degree in Mechanical Engineering. He was associated with the Bureau of Aeronautics, U. S. Navy, for some time after graduation and then became a sales engineer for B. F. Sturtevant Company, specializing in industrial ventilation. His experience resulted in his being called to the U. S. Public Health Service as a regional director in charge of training field engineers to make qualitative plant surveys, as part of a national survey made during 1935 and 1936. Upon completion of this project, he joined the Connecticut State Department of Health as an industrial hygiene engineer, acting as a consultant to Connecticut industry in the control of occupational diseases arising out of air contamination. He then transferred to the design and development section of the Army Industrial Hygiene Laboratory which was formerly connected with the Johns Hopkins School of Health and is now at Edgewood Arsenal. Mr. Postman is now an industrial hygiene engineer for the Employers Mutual Liability Insurance Company of Wausau, Wisconsin. His headquarters are in the New York office of the company and his activities cover the entire east coast territory, under the supervision of Dr. E. G. Meiter, director of Employers' Industrial Hygiene Laboratory. Mr. Postman has contributed many articles to technical journals during the past few years on the control of occupational health hazards in industry.

. . . Since the Last Issue

H. D. Kinsey has been appointed works manager for **Carbide and Carbon Chemicals Corp.,** Unit of Union Carbide and Carbon Corp., New York. Mr. Kinsey was formerly general superintendent of the atomic energy plant operated for the Government by Carbide and Carbon Chemicals Corp., at Oak Ridge, Tennessee. The post of assistant works manager has been taken over by **R. K. Turner,** who had served since 1940 as superintendent of the corporation's plant at South Charleston, West Virginia. Mr. Turner joined the organization in 1924 at Clendenin, West Virginia, and moved to South Charleston in 1925. **T. R. Ragland,** who joined the staff at this plant in 1928 and has been assistant superintendent since 1940, succeeds Mr. Turner as superintendent. At the South Charleston plant **G. H. Sears** is now assistant superintendent in charge of industrial relations, and **E. P. Shetter** is assistant superintendent in charge of the gas separation and related departments.

General Controls Co., Glendale, Cal., announce the appointment of **Edgar P. Hollister** as factory branch manager of their New York Office, 101 Park Avenue. Mr. Hollister was formerly associated with Bendix Aviation Corporation.

The **Allied Control Valve Co., Inc.,** of South Norwalk, Conn., has acquired the Solenoid Division of the Henry Valve Company of Chicago. **Hal McPherson,** formerly with the Henry Valve Company as chief engineer, is now with Allied as vice-president in charge of engineering.

The **Brown Instrument Co.** division of **Minneapolis-Honeywell Regulator Co.** has opened a sales and service office at 16 State Street, Rochester, N. Y. The new Brown office is under the supervision of **Gerald L. Britton. O. J. Richardson** has been appointed industrial manager of the Brown Instrument Co. and **George W. Brown** has been appointed industrial manager of the Cincinnati office.

Air-Maze Corp., engineers and manufacturers of air and oil filters, announce the resignation of **Jules Gratiot** and the appointment of **W. B. Watterson** as sales manager of the corporation. Mr. Gratiot has resigned to become direct factory representative and field engineer for the company in Arizona and California. Mr. Watterson, who has been connected with Air-Maze since 1942 in various sales promotional capacities, has more recently been factory representative for the Ohio territory. Mr. Gratiot, vice-president and sales manager since 1943, was formerly a partner in the firm of Treidler & Gratiot, Air-Maze distributors in Southern California.

W. B. Watterson

The appointment of **Edward B. Maire** as manager of the Chicago branch was recently announced by **General Controls Co.**, Glendale, California. Mr. Maire will devote his efforts to serving users of Automatic Pressure, Temperature and Flow Controls in Illinois, Indiana, Wisconsin, Iowa. Minnesota, North Dakota and South Dakota.

J. B. Dannenbaum, 3940 Main St., Houston, Texas, has been appointed agent by **S. P. Kinney Engineers, Inc.**, to handle the Brassert automatic self-cleaning water strainer in the southern Texas district.

Surface Combustion Corp., manufacturer of Janitrol heating equipment, announces the appointment of **Mark E. Ward** as a design engineer at its Columbus, Ohio plant. Mr. Ward formerly was with the American Gas Association testing laboratory at Cleveland.

R. B. Jennings, recently discharged as commander in the U. S. Naval Reserve Engineering Corps, has resumed duties as manager of the Columbus branch office of **The Trane Company**, La Crosse, Wis.

George B. Cushing has been named manager of sales promotion for the **National Supply Co.**, it was announced recently by A. E. Walker, chairman of the board and president. Mr. Cushing, sales promotion manager for A. M. Byers Co. for the past 17 years, will direct the sales promotion activities of National Supply Co. including the Spang-Chalfant, Superior Engine, and oil field machinery and equipment divisions. These activities will include the advertising and market development programs of the company. In announcing Mr. Cushing's appointment, Mr. Walker stated that **A. P. Colby** will continue as the company's advertising manager.

G. B. Cushing

Joseph F. Heil was elected president of **The Heil Co.**, Milwaukee, recently at the annual meeting of its Board of Directors. **Julius P. Heil**, founder of the company and president since its inception, will continue actively in the business as director and treasurer.

WHITLOCK
DEAERATING
FEEDWATER
HEATING
SYSTEM
COMPACT • EFFICIENT
The Whitlock Deaerating Feedwater Heating System soon pays for itself by preventing the corrosion of boiler tubes, steam lines and auxiliary equipment: normal oxygen concentrations which very rapidly consume iron are reduced to the required minimum. The Whitlock system can be installed in a very limited space and its construction is simple, without complicated internal parts. High deaerating efficiency is maintained for years, with very little attention . . . the Whitlock name is your guarantee of durability and trouble-free performance.
Ask our engineers to analyze your requirements
Write for Bulletin 645
THE WHITLOCK MANUFACTU
NEW YORK

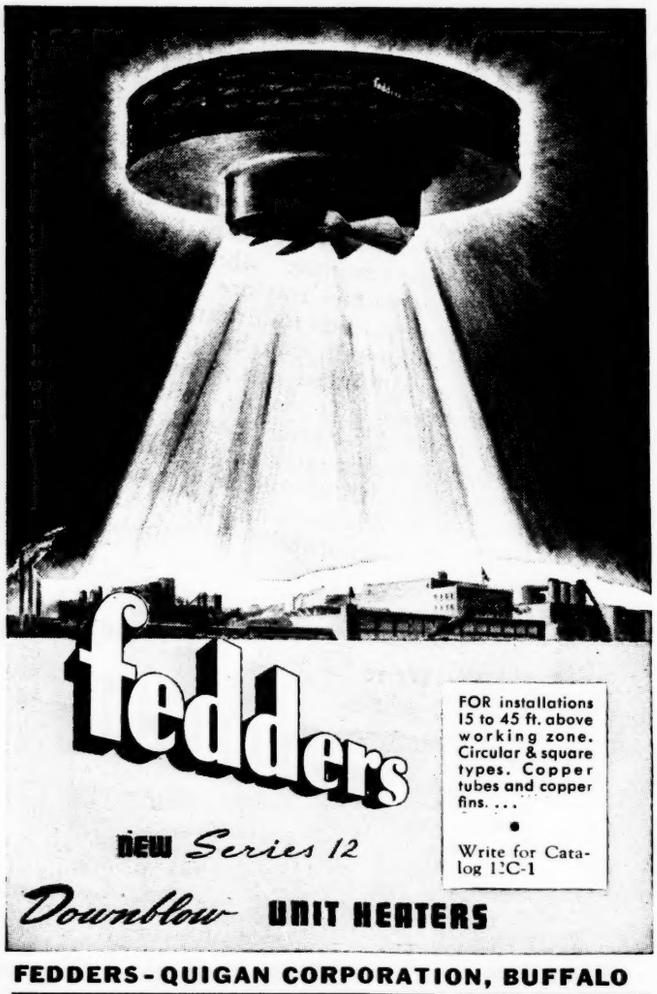
CHECK BLOWERS AND EXHAUST SYSTEMS with

The Alnor Velometer

Air velocity can be measured directly and quickly with the Alnor Velometer. This convenient instrument gives you instantaneous direct readings in feet per minute, reliable check of exhaust system operation. Extension jets permit use in ducts and many other places inaccessible by other means.

The Alnor Velometer is built in several standard ranges, 0-200 to 0-6000 fpm, and up to 20 inches static on total pressure. Special ranges available up to 24,000 fpm. Write for velometer bulletin with complete description.

ILLINOIS TESTING LABORATORIES, INC.
420 NORTH LA SALLE STREET • CHICAGO 10, ILLINOIS


fedders
NEW Series 12
Downblow UNIT HEATERS
FOR installations 15 to 45 ft. above working zone. Circular & square types. Copper tubes and copper fins. . . .
Write for Catalog 12C-1

FEDDERS-QUIGAN CORPORATION, BUFFALO

Eastern sales and display offices have been opened by the **Eureka Williams Corp.** in the Empire State Building, New York City, occupying 15,000 square feet of space on the 80th floor. The Eureka Division's eastern headquarters will be in charge of **George H. Wilkens,** eastern sales manager. Les Brown, New York district manager of the Williams division, also will make his headquarters at the new offices.

Two young war heroes (one Army and one Navy) have joined the staff of **McDonnell & Miller, Inc.,** manufacturers of boiler water feeders and low water cut-offs.

Former Captain **Charles A. Nelson** was with the 5th Infantry Division under General Hodges' First Army in the Normandy invasion, and fought through France and the Rhineland with General Patton's famous Third. He rose from his commissioned second lieutenancy in the Infantry Reserve of the R.O.T.C. at the University of Wisconsin in 1939, to Captain in March 1943.

C. A. Nelson

J. A. Thvedt

Former Lieutenant Commander **John A. Thvedt** took examinations for entrance into the Naval Air Force and was called to active duty in April 1940 as a Seaman Second Class. After a year's naval air training, he was commissioned an Ensign and designated a Naval Aviator. He served in the training program in the United States. From July 1943 until December 1944, based on the U.S.S. Intrepid, known as the "Old Lady," Commander Thvedt was a part of an air group that shot down 683 enemy planes and sank a total of 368,000 tons of shipping, and was one of only 21 surviving pilots of the original 48 in his Squadron. Both men have been decorated for their service and valor. New duties at McDonnell & Miller have not been defined.

Bevington & Williams, Inc., consulting engineers, Pythian Bldg., Indianapolis, have taken over the complete sales and engineering of the Carpenter Monolithic Concrete Floating Floor & Piping System. They will continue the work which the late Martin R. Carpenter pioneered in the design of the all purpose permanent floor which has been installed in many ice arenas and public auditoriums throughout the country. The Carpenter office at 1560 Ansel Rd., Cleveland, Ohio, will continue to function, along with the engineering headquarters in Indianapolis.

Bernie G. Silberstein, manager of the **Ilg Electric Ventilating Co.** branch office in Cincinnati, Ohio, has been appointed Ohio Valley district manager, according to an announcement by P. D. Briggs, vice-president and general sales manager of Ilg. In his new capacity, Silberstein will supervise engineering and sales activities of Ilg Branch Offices in Cincinnati, Columbus, Louisville, Knoxville, and Charleston, West Virginia.

On May first, Lieutenant Commander **Robert S. Green,** now on terminal leave following Pacific fleet duty, will become president of the **A. P. Green Fire Brick Co.,** succeeding his father, **Allen P. Green,** founder of the company, who moves up to the post of chairman of the board.

John Hammond has joined the **Allied Control Valve Co., Inc.**, of South Norwalk, Conn., as vice-president and general manager. Mr. Hammond, who was formerly with General Controls, has had wide experience in the control equipment field, particularly in the use of motor and solenoid operated valves.

The **Perfex Corp.** of Milwaukee announces the appointment of **Gil A. Churchill** as manager of the Chicago branch and **B. F. Werb** as manager of the newly-formed Milwaukee branch.

Plans have been completed for the establishment of a new **Borg-Warner** unit to be known as the **Norge-Heat** division. **Howard E. Blood** has been named president of Norge-Heat. Mr. Blood is also head of the corporation's Norge and Detroit Gear divisions and a director. The division was created for the manufacturing and marketing of Norge residential heating and conditioning equipment. Outlining the projected operations of the new unit, Mr. Blood stated that initial production would include output of several improved models of automatic, thermostatically-controlled oil-fired furnaces, utility room and under floor heating units, oil-fired water heaters and air filter units. These will be built to meet the requirements of every home owner, he said.

H. E. Blood

Melvin C. Shaw has been named manager of the blower and compressor department at the **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis. He succeeds John Avery, who has resigned to become president of a blower corporation in Indiana. He has been with Allis-Chalmers since 1914 when he was graduated from the University of Washington, and since 1935 has been chief engineer of the department he will now head.

Charles E. Wilson, vice-president of **Worthington Pump and Machinery Corp.**, Harrison, N. J., has been elected president of the **Worthington-Gamon Meter Co.**, of Newark, N. J., a subsidiary engaged in the manufacture of liquid meters. C. A. Packard was elected vice-president and comptroller.

C. E. Wilson

D. V. Petrone

Don V. Petrone has rejoined the **Ice-Air Conditioning Co.** as vice-president in charge of sales, after three and one-half years of active duty with the Army Air Forces. Prior to entering the Army, Mr. Petrone was export manager of the Typhoon Air Conditioning Co., a division of his present firm. In this capacity, he spent three years supervising the firm's activities in South America.

Harvey-Whipple, Inc., manufacturers of Master Kraft Oil Heating Equipment, announces the appointment of **N. S. Holleman** of Winston-Salem, N. C., as Master Kraft factory representative covering the States of Virginia and North Carolina.

Unless you are pretty sharp-eyed, you'll pass by "old man walking stick" as just another dead twig on a tree.

And there are a lot of other things that look different from what they really are . . . for example, certain cut-rate plumbing supplies. The wise plumber will avoid the pitfalls that come with inferior merchandise by relying on the reputable jobber in his vicinity.

Dollar for dollar, the trade-marked, quality merchandise he stocks is your best plumbing buy.

KUHNS BROTHERS CO.
DAYTON 1, OHIO

K
CAST FITTINGS

"K" fittings are carried in stock at Malleable Iron Fittings Co., Branford, Conn.; M. I. F. stocks at Kuhns Bros. Co., Dayton, Ohio.

DE-STA-CO

Blower Wheel Housings

of Standard Dimensions

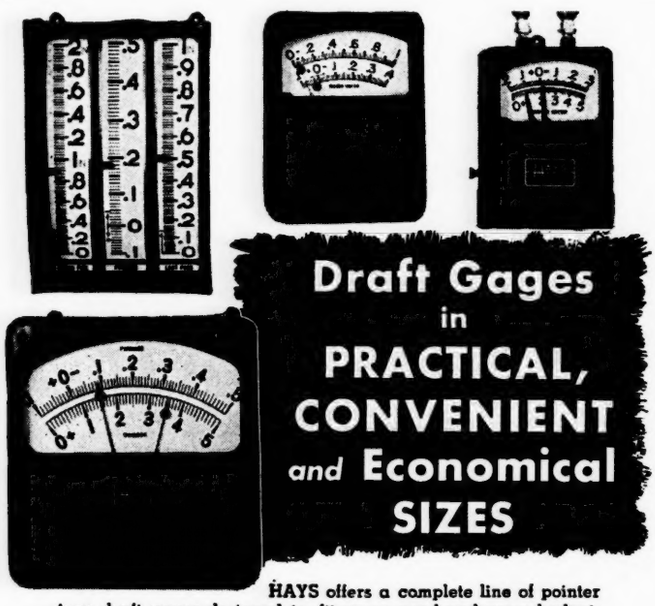
Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.

Established Over 30 Years

375 Midland Ave • Detroit 3, Mich.



Draft Gages in PRACTICAL, CONVENIENT and Economical SIZES

HAYS offers a complete line of pointer type draft gages designed to fit every need and every budget.

No longer is it necessary to buy a large gage when a small one is available that will serve quite as well or better. No longer need you try to make one size gage handle all drafts.

All these gages have the famous Hays slack diaphragm unit for ranges of draft or pressure from 0 to 120 inches of water. For ranges above 100 inches, Bourdon Tubes are used. For full description of these better gages, in all sizes and ranges, send for Bulletin 45-667.

The HAYS CORPORATION

COMBUSTION INSTRUMENTS AND CONTROL

MICHIGAN CITY, INDIANA, U.S.A.

Hammel-Dahl Co., of Providence, R. I., designers and manufacturers of automatic control equipment, announces the appointment of **Russell Milham** as district sales engineer, in charge of their Chicago and Mid-West district.

S. J. Dowling is now a district representative for Oil-O-Matic in New York, according to an announcement by W. A. Matheson, vice-president in charge of the **Williams Oil-O-Matic Division, Eureka Williams Corp.** From 1935 to his coming with Oil-O-Matic in 1945, Mr. Dowling was general manager for Public Service Engineering and Heating Co., Bronx County distributors of Socony fuel oil and Delco oil burners. While with the Bronx County organization, Mr. Dowling was in complete charge of all sales, installation and service.

George D. Lain has been appointed research engineer of the Committee on Steel Pipe Research of the **American Iron and Steel Institute.** The committee carries on industry-wide research and development of the use of steel pipe. Mr. Lain, a native of Jackson, Pa., was recently production manager of the Consolidated Machine Tool Co., Rochester, N. Y. A graduate of Carnegie Institute of Technology, he has had broad experience in the pipe field. He served as industrial and research engineer with the A. M. Byers Co. of Pittsburgh from 1916 to 1925. From 1925 to 1938 he was with the Reading Iron Co. in various technical and operating positions, and became general superintendent of tube works. Mr. Lain's experience also has included production, maintenance and executive positions with the Carnegie Illinois Steel Corp., Rustless Iron and Steel Corp., Babcock & Wilcox Tube Co., and other steel producers.

G. D. Lain

Frank L. Wadsworth, professional engineer, will soon resume his pre-war business connection as engineer associated with **Siegmund Firestone,** architect and consulting engineer of Rochester, N. Y. A veteran of World War I and for 15 years a Naval Reserve officer, Mr. Wadsworth went with the Navy Department Bureau of Yards and Docks in Washington at the outbreak of World War II to design high pressure power plants for various naval bases. In April 1943 he was transferred to the U. S. Naval Center, Sampson, N. Y., as chief mechanical engineer for the base. With the center scheduled to close about April 1st, Mr. Wadsworth will be released sometime this spring and return to mechanical-electrical engineering work in Rochester.

The **Emerson Electric Mfg. Co.,** St. Louis, Mo. has announced its postwar expansion program which involves moving all manufacturing and office facilities from its downtown buildings, to one of St. Louis' newest and most modern plants, located at 8100 Florissant Ave., following lease arrangements with the Reconstruction Finance Corp.

The Heating and Ventilating Division of **Evans Products Co.,** Detroit, has been renamed **Thermo-Aire Division,** E. S. Evans, Jr., president, has announced. The Thermo-Aire Division, which will continue to manufacture bus and truck heating and ventilating equipment, was renamed following development and improvement of the Thermo-Control Fan, a thermostatically controlled variable pitch fan. **A. R. Lintern,** manager of the former Heating and Ventilating Division, continues as manager of the Thermo-Aire Division.

American Engineering Co., Philadelphia, announces the appointment of **Roy A. Stipp,** Blue Building, Greenville, S. C., as AE Perfect Spread and Taylor Stokers sales representative in the Carolinas and eastern Tennessee.

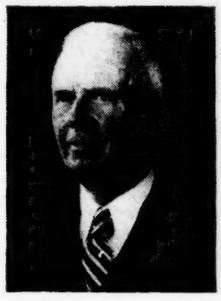
O. E. Norberg has been promoted to manager of refrigeration and appliance engineering in the manufacturing division of **The Crosley Corp.** He has been connected with the company for the past five years and, previous to his recent promotion, had been chief engineer of refrigeration.

During the World War II, Mr. Norberg had charge of engineering on airplane gun turrets built by The Crosley Corporation.

Mr. Norberg was with the Gibson Refrigeration Co. for two years and with the Norge Division of Borg Warner Corp. for eight years before he joined Crosley.

Leslie Co., Lyndhurst, N. J., manufacturers of regulators, controllers and whistles, announces several changes in officers as a result of elections held at recent annual meeting. **S. Inglis Leslie**, president of the company since 1926, has been elected chairman of the board of directors. **John S. Leslie**, who has been vice-president and general manager since 1943, was elected president. **J. M. Naab** was reelected vice-president and treasurer.

J. S. Leslie



S. I. Leslie

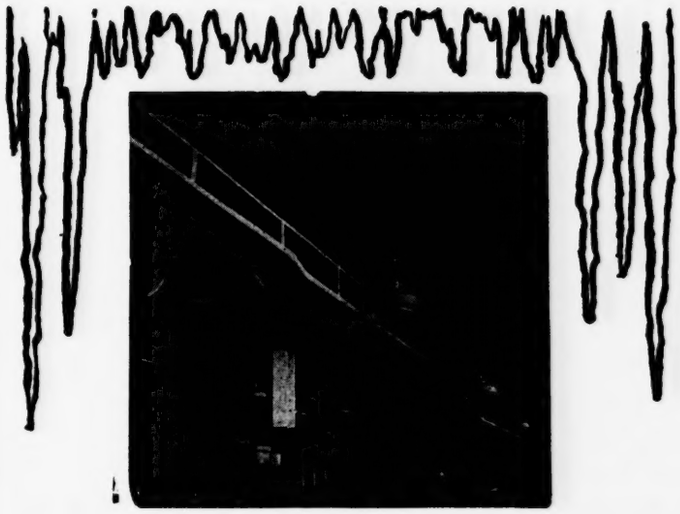
The heating, piping and air conditioning industry will be heavily represented in the first annual Construction Industries Exposition and Home Show of Southern California, it is anticipated by Louis C. Breer, president of the **Heating, Piping and Air Conditioning Contractors Association of Southern California.** The show will be presented by 14 building and allied trade associations of which Mr. Breer's organization is one. It will be held July 12 to 21, inclusive, in the Pan Pacific Auditorium, Los Angeles. The show will be staged by the Tabery Corporation. Reservations for display space may be made with this firm at 3443 South Hill Street, Los Angeles 7, California.

Appointment of the B & B Combustion Co., St. Louis, as the Missouri and lower Illinois representative of the **Canton Stoker Corp.**, Canton, Ohio was announced recently. The company is headed by **E. S. Bremerman.** Headquarters are at 4030 Chouteau Ave., St. Louis.

Webster Electric Co., Racine, Wis., announces the appointment of **K. J. Norman** as advertising manager. Mr. Norman will be in charge of a complete advertising program on the Webster Electric line of intercommunication and sound systems, fuel units and transformers for the oil burner industry and the new Thermodrive control for heating and air conditioning systems.

Iron Fireman Mfg. Co., manufacturer of domestic, commercial and industrial stokers, turned in a net profit of $776,876.51 in 1945 after providing $2,003,370.00 for taxes, it was announced by T. H. Banfield, president, following a recent directors' meeting in the company's home offices at Portland, Ore.

G. H. Gaites, regional sales supervisor of the Cleveland and Pittsburgh sales territories of **The Bristol Co.**, has been appointed district manager of the company's New York office.



AIR CONDITIONING

Insulated Ducts are a NECESSITY for carrying cool or low temperature air. A DUX-SULATION insulated cooling system operates three times as efficiently as an uninsulated system and saves three out of every four degrees of temperature rise.

Savings with Dux-Sulation actually go much further—with less original equipment investment, such as smaller fans and motors—lower fan speeds, less power consumption and longer "off-cycles".

Bare ducts are definitely wasteful!—with cool air as well as warm air, in direct ratio to the temperature of the air in the area surrounding the duct work. The greater the inside and outside temperature difference, the greater the waste. Dux-Sulation corrects this waste once and for all.

DUX-SULATION

- **Saves 75% of bare duct heat loss.**
- **Thermal Insulating Efficiency of 70%.**
- **K Factor .27 B.T.U.**
- **Frictional Resistance F = 0.0001322.**
- **Deadens metallic noises when applied to outside of duct.**
- **Absorbs 70% of air-borne noises.**

Asbestos protected Dux-Sulation pays for itself summer and winter in fuel savings alone. Many extra benefits are fully explained in our eight-page, three-color bulletin you may obtain by simply sending in the coupon below—no obligation of course.

GRANT WILSON, INC.

141 WEST JACKSON BLVD AT LA SALLE ST CHICAGO 4, ILL
22nd Floor, Board of Trade Bldg Phone Wabash 8220

Send bulletin No. 407-V containing the full story of DUX-SULATION—the all purpose insulation.

FIRM NAME.....

STREET.....

CITY.....**STATE**.....

ATTENTION OF.....

Phillips Float Controls

Another Phillips Product

. . . PILOT OPERATED LIQUID CONTROL VALVE

May be piloted by either float, thermal or electric valve.

The recognized higher efficiency rate of a flooded operated evaporator in a refrigerating or air conditioning system is further emphasized when the evaporator is used in conjunction with Phillips Float Controls. Maximum B. T. U. transfer is assured. These controls respond so instantly to any wide variations in load that their use is indicated on practically all installations. Available capacities: Freon, 20 to 500 tons; Ammonia, 1 to 2000 tons. For high or low side applications. Write for NEW Bulletin.

The Home of Phillips Regulating Valves and Float Controls
Established in 1929

H. A. PHILLIPS & COMPANY
3255 W. CARROLL AVE., CHICAGO, ILLINOIS

How much fuel, energy and equipment could you save *by saving conditioned air?*

Converting 1000 CFM of stale, odorous air to fresh air with Dorex *activated carbon* Air Recovery Equipment, instead of bringing in and conditioning outdoor air, saves:

100,000 BTU of installed heating capacity	Per 1000 CFM of heated or cooled air saved
3 tons of installed refrigeration	
1800 KW hours of current per cooling season	
1500 gallons of fuel oil or	
9 tons of coal per heating season	
Incidental water consumption and maintenance	

The above savings are figured for average temperate zones. Some installations have shown greater savings, some less. But in every case, Dorex Air Recovery has *converted contaminated air to fresh air* at a cost much below that required to replace it with an equal volume of outdoor air.

We will be glad to give you the details on actual savings in typical installations or estimate the savings on any existing or planned system. For full information call the nearest District Representative or write Dept. E-9.

W. B. CONNOR ENGINEERING CORP.

AIR DIFFUSION AIR PURIFICATION AIR RECOVERY

112 East 32nd Street New York 16, N. Y.

E. H. Davison has been named manager of heating sales by W. A. Matheson, vice-president in charge of the **Williams Oil-O-Matic Division, Eureka Williams Corp.** Mr. Davison's Oil-O-Matic experience, covering both field and home office sales, dates back to 1923. In 1935, Mr. Davison joined the program production division of the National Broadcasting Co. He returned to Oil-O-Matic in 1941 as manager of the eastern regional division and has been acting manager of heating sales since September, 1945.

E. H. Davison

The **American Society of Heating and Ventilating Engineers** announces the appointment of **Clyde A. McKeeman,** as Assistant to the President of the Society. According to President Alfred J. Offner, New York consulting engineer, Mr. McKeeman will represent the society in securing the interest and participation of industry in the society's research activities.

H. F. Spoehrer, vice-president of the Sporlan Valve Co., St. Louis, was elected president of the **Refrigeration Equipment Manufacturers Association** at its Spring Conference in Chicago. He succeeds **F. J. Hood,** secretary-treasurer of the Ansul Chemical Co., Marinette, Wis., as head of the association which now comprises more than 90 members representing every branch of the refrigeration and air conditioning fields. Other new officers chosen at the REMA meeting were **Edward M. Flannery** of the Bush Manufacturing Co., Hartford, Conn., vice-president; **Guy J. Henry** of the Henry Valve Co., Chicago, treasurer; and **C. H. Benson** of the Imperial Brass Mfg. Co., Chicago, treasurer. Newly elected to the board of directors were K. B. Thorndike, manager of the Chicago office of the Detroit Lubricator Co.; G. E. Graff of Ranco, Inc., Columbus, Ohio; R. H. Israel, Virginia Smelting Co., West Norfolk, Va.; H. F. Hildreth of Westinghouse Electric Corp., Springfield, Mass.; and J. W. Krall of the Tyler Fixture Corp., Niles, Mich.

The Pittsburgh Corning Corp. announced plans for a $300,000 expansion of existing facilities for the manufacture of Foamglas, a glass insulation material, at its Port Allegany, Pennsylvania plant. Construction of a new plant to house a melting furnace will begin as soon as weather conditions permit. Additional buildings designed to house batch handling and cullet crushing equipment will be erected at the same time, according to the Pittsburgh Corning Corporation announcement.

Walter P. Davis has been appointed managing director of the **Indoor Climate Institute,** with headquarters in Detroit, according to an announcement by T. A. Crawford, president. Mr. Davis, who has been in Buffalo, New York, assumed his new duties March 15th. During the past 9 years he has been supervisor of the promotional activities with the Buffalo Niagara Electric Corporation; Executive Secretary of the Oil Heat Association of Western New York; Secretary of the Buffalo Stoker Association; Assistant Secretary of the Electric Association of the Niagara Frontier and Executive Secretary of the Indoor Climate Council of Western New York.

W. P. Davis

Parks & Hull Appliance Corp., Baltimore, Md., has changed its name to **Roche & Hull, Inc.**

The Potter & Brumfield Sales Co. has been incorporated in the State of Illinois to handle all domestic and export sales of relays, process timers and electro mechanics manufactured by the Potter & Brumfield Mfg. Co., Inc., Princeton, Ind. An office has been opened at 5409 W. Washington Blvd., Chicago, and operations of the company will be under direction of **Ralph T. Brengle**, president.

The Ohio Brass Co., Mansfield, Ohio, has named **John R. Imler** assistant manager of the valve department. Mr. Imler has rejoined the company after five years in the army, serving with the 37th division for three years in the Pacific theatre as a first lieutenant. He has been connected with the company since 1935 in the order department and the engineering department. In his new position Mr. Imler will coordinate factory production and shipments of valves.

Howard P. Vermilya, Research Director of the **John B. Pierce Foundation**, has been appointed to the staff of Wilson W. Wyatt, National Housing Expediter and Administrator of the **National Housing Agency**, as a consultant on technical problems.

Northern Equipment Co., Erie, Pa., announces the appointment of **The Kissick Co.**, 1524 Chestnut St., Philadelphia, Pa., as sales and service representatives for Copes feed water regulators, pump governors, desuperheaters and allied equipment. The territory served includes Southern New Jersey, Southeastern Pennsylvania, Eastern Maryland and Delaware.

Harry G. Richardson has retired from the partnership of **Williams & Richardson**, Salt Lake City, due to ill health, after 27 years of continuous association. **Earl V. Gritton** and **Dale R. Wilde** have acquired Mr. Richardson's partnership interest, and **Gilbert W. Williams** has divided his interest with his son, **Richard C. Williams.** The name of the association has been changed to **Williams, Gritton & Wilde.**

York Corp. has formed an International Division with headquarters at 50 Broadway, New York City, according to S. E. Lauer, president. **James C. Tweedell**, York's export manager since 1935 and acting general sales manager during the war period, is now manager of the new division. **S. L. Cordis** is the assistant manager, and **C. E. Renninger** is sales manager of the International unit.

Edward E. Helm, general sales manager, **Reliance Electric & Engineering Co.**, has been elected sales vice president of the company. All other officers were re-elected. Helm has been with Reliance since he graduated in electrochemical engineering from Pennsylvania State College in 1924. Subsequently, he managed both the Birmingham and Philadelphia sales territories, where he was particularly active in application engineering work in the steel, textile and paper industries. His appointment as general sales manager of the company was made in December 1944.

The appointment of **A. Lightfoot Walker** as his executive assistant was announced by R. S. Rheem, president of **Rheem Mfg. Co.** He will make his office at the eastern headquarters of the company in New York. He has served as general manager of Rheem's Australian division since the formation of that subsidiary in 1937. Under his management Rheem Australia expanded its Sydney plant and added others at Melbourne and Brisbane. A. B. Taylor of Sydney succeeds him in Australia. **C. L. Hewitt, Jr.**, former colonel, A.U.S. Air Corps, has been appointed manager of sales for the heating equipment division of Rheem.

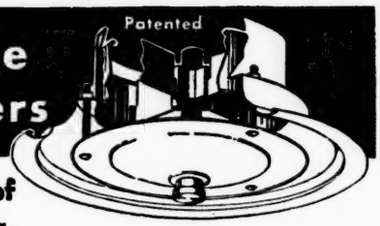
STILL USING the sand-and-heat method to bend steel and wrought iron pipe? Then read what Philip E. Nolan, owner, Westport Plumbing & Heating Co., Kansas City, Mo., says about his GREENLEE Pipe Bender.

"Our GREENLEE saves us 50% working time on bends, cuts material spoilage 25%, and provides 66% saving on fittings and manufactured bends. In addition we get a neater job, and friction heads are cut 90% on long-radius bends."

Do the job easier, faster, *better* with a GREENLEE . . . one-man-operated, compact, portable . . . for on-the-job, smooth, *accurate* bending of pipe up to 4½" size. Write today for complete information. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2324 Twelfth Street, Rockford, Illinois.

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

Adjustable Air Diffusers



Any desired condition at your fingertips

For better mixing of room and supply air, more uniform temperature throughout the occupied zone and noiseless air diffusion.

Kno-Draft Type K Adjustable Air Diffuser with Type D volume damper

Whether they are used in heating, cooling, ventilating or combined systems, Kno-Draft Adjustable Air Diffusers can be adjusted quickly and accurately for system balancing and individual or seasonal requirements. By simply turning the air adjustment screws (easily accessible from under the unit) the inner cone may be raised or lowered to secure any angle of air direction required. The built-in volume damper (regulated by the hand-turning knob) varies the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Free handbook: contains clear sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers. Please write Dept. E-14 for your copy, using your company letterhead.

W. B. CONNOR ENGINEERING CORP.

AIR DIFFUSION AIR PURIFICATION AIR RECOVERY

114 East 32nd Street New York 16, N. Y.

W B CONNOR

Conseco 15 ton freon heat exchanger, Strand Theatre, N. Y.

Air Conditioning HEAT EXCHANGERS

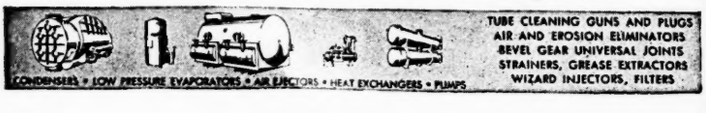
CONSECO

Twenty years' specialized experience designing, fabricating and servicing heat exchangers assure sound design, quality construction and economical operation with any type refrigerant. Engineering assistance gladly furnished. Write.

Let our engineering department help you with your problem

CONDENSER SERVICE & ENGINEERING CO., INC.

63 RIVER STREET, HOBOKEN, N. J. • *Phone Any Time*


TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS
CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

Edward L. Schulz has joined the **Gordon Lozier Corp.**, manufacturers and distributors of air conditioning, commercial and industrial refrigeration equipment and store fixtures, as vice-president and director. In his new capacity, Mr. Schulz will head the company's air conditioning and industrial refrigeration engineering and sales department.

The Northern West Virginia Coal Association of Fairmont, West Virginia is the latest producer group to join the **Coal Producers Committee for Smoke Abatement.** The addition brings to five the number of producing districts actively affiliated with smoke abatement.

At the annual meeting of the **Propeller Fan Manufacturers Association** held in Detroit, the following officers were elected for the ensuing year: President, **M. L. Aitken;** vice-president, **H. M. Guilbert;** acting secretary, **L. O. Monroe.** Mr. Aitken is manager of Propellair, Inc., Springfield, Ohio, and Mr. Guilbert is manager of the Propeller Fan Division of B. F. Sturtevant Company, Boston, Mass.

INDUSTRIAL DEGREE-DAYS
February, 1946

City	55F Base	45F Base
Baltimore, Md.	474	217
Buffalo, N. Y.	850	570
Chicago, Ill.	701	421
Cleveland, Ohio	676	399
Detroit, Mich.	797	517
Indianapolis, Ind.	577	320
New York, N. Y.	660	383
Philadelphia, Pa.	549	281
Pittsburgh, Pa.	564	292
St. Louis, Mo.	462	156

CANADIAN DEGREE-DAYS FOR FEBRUARY, 1946

City	February 1946	February Normal	Cumulative, Sept. 1 to Feb. 28 1945-46	Cumulative, Sept. 1 to Feb. 28 Normal
Calgary, Alta.	1201	1355	6726	6666
Charlottetown, P. E. I.	1327	1338	5609	5666
Crescent Valley, B. C.	966	1112	5333	5743
Edmonton, Alta.	1571	1512	7543	7283
Fort William, Ont.	1683	1582	7549	7204
Grand Prairie, Alta.	1178	1456	8316	7456
Halifax, N. S.	1173	1170	5038	5068
London, Ont.	1215	1240	5447	5253
Medicine Hat, Alta.	1285	1406	6677	6438
Moncton, N. B.	1383	1392	6078	6106
Montreal, P. Q.	1520	1392	6367	6075
North Bay, Ont.	1708	1492	7243	6653
Ottawa, Ont.	1568	1459	6539	6382
Penticton, B. C.	924	969	4654	4779
Porquis Junction, Ont.	1938	1764	8227	8064
Prince George, B. C.	1204	1305	6541	6677
Quebec City, P. Q.	1523	1481	6550	6688
Regina, Sask.	1694	1764	8239	8137
St. John, N. B.	1291	1266	5639	5652
Saskatoon, Sask.	1764	1635	8392	7911
Toronto, Ont.	1189	1206	5089	5154
Vancouver, B. C.	678	736	3745	3797
Victoria, B. C.	627	689	3396	3414
Windsor, Ont.	1078	1148	4862	4877
Winnipeg, Man.	1800	1775	8222	8091

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports a slight revision in the figure for January for Charlottetown, P. E. I., as published in last month's issue. Corrected figure is 1445.

COMING EVENTS

APRIL 22-27, 1946—First National Plastics Exposition, Grand Central Palace, New York City, under the sponsorship of the Society of the Plastics Industry, 295 Madison Ave., New York. Further details from Ronald Kinnear, chairman of exposition committee.

APRIL 23-27, 1946—National Oil Heat Exposition in conjunction with the annual convention of Oil-Heat Institute of America, Commercial Museum, Philadelphia, Pa. Headquarters at Benjamin Franklin Hotel; C. F. Curtin, secretary of the Institute at 30 Rockefeller Plaza, New York 20, N. Y.

MAY 7-9, 1946—Annual meeting and exhibition of the National Association of Corrosion Engineers, President Hotel and Municipal Auditorium, Kansas City, Mo. Elton Sterrett, 318 Southern Standard Bldg., 711 Main Street, Houston 2, Tex.

MAY 20-25, 1946—National Marine Exposition, Grand Central Palace, New York City, under the sponsorship of the Propeller Club of the United States. Roger E. Montgomery, general manager, National Marine Expositions, Inc., 17 Battery Place, New York, N. Y.

MAY 22-25, 1946—57th Annual Convention of the Heating, Piping and Air Conditioning Contractors National Association, Ritz-Carlton Hotel, Atlantic City, N. J. Joseph C. Fitts, Secretary of the Association, 1250 Sixth Ave., New York 20, N. Y.

JUNE 3-5, 1946—Summer meeting of the American Society of Refrigerating Engineers, Hotel St. Paul, St. Paul, Minn. David L. Fiske, Secretary, 40 W. 40th St., New York, N. Y.

JUNE 3-6, 1946—Annual Meeting of the National District Heating Association, The Cavalier Hotel, Virginia Beach. John F. Collins, Jr., Secretary, 827 N. Euclid Ave., Pittsburgh 6, Pa.

JUNE 25-26, 1946 — Mid-year convention, National Warm Air Heating and Air Conditioning Association, Edgewater Beach Hotel, Chicago, Ill.

SEPTEMBER 16-20, 1946 — 1946 Exhibit and Conference of the Instrument Society of America, to be held in Pittsburgh, Pa. Paul G. Exline of the Society at 1117 Wolfendale St., Pittsburgh 12, Pa.

OCT. 28-NOV. 1, 1946—REMA annual all-industry refrigeration and air conditioning show, Cleveland Public Auditorium, Cleveland, Ohio. Refrigeration Equipment Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

WEEK OF NOVEMBER 11, 1946 — 74th Annual Meeting of the American Public Health Association, to be held in Cleveland, Ohio. Further details from Dr. Harold J. Knapp, Health Commissioner, Cleveland, Ohio.

JANUARY 27-31, 1947—7th International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, Ohio. Sponsored by The American Society of Heating and Ventilating Engineers in conjunction with their 53rd Annual Meeting. Charles F. Roth, manager, International Exposition Co., Grand Central Palace, New York.

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

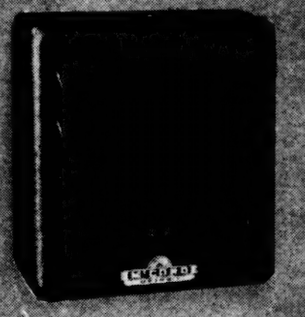
BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES

All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS



A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.